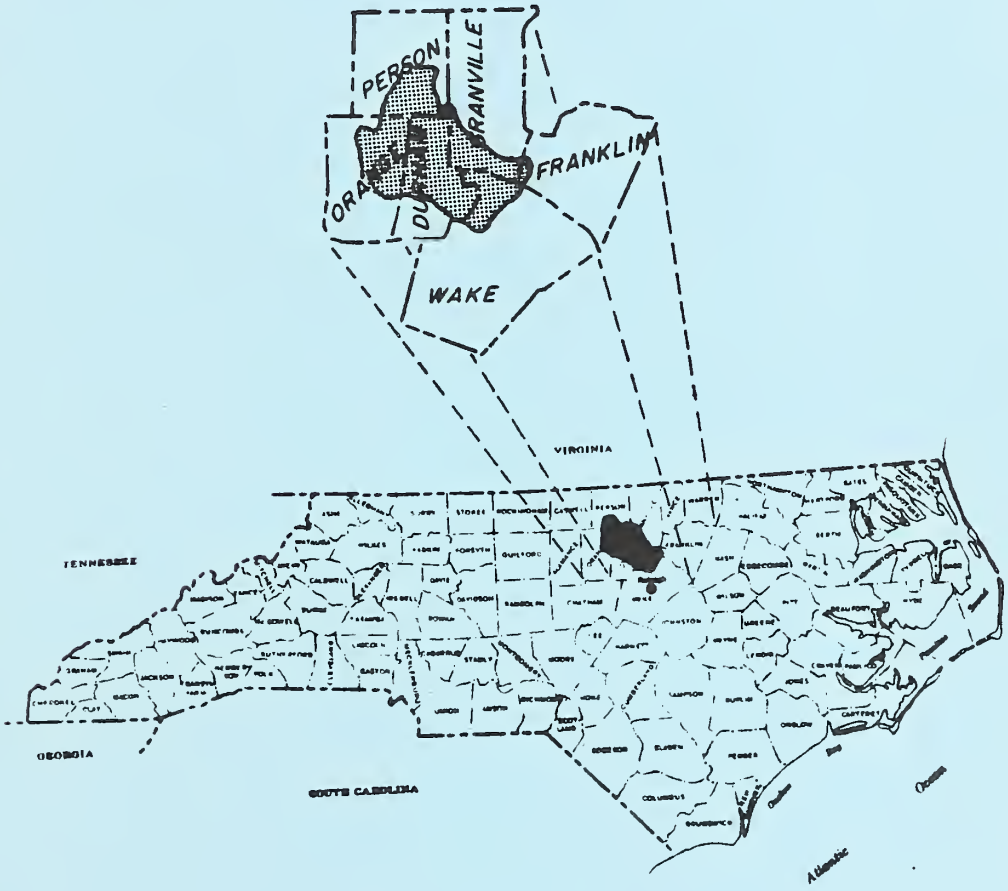
UPPER NEUSE RIVER EROSION STUDY

Durham, Franklin, Granville, Orange, Person and Wake Counties, North Carolina



September, 1983

UPPER NEUSE RIVER STUDY

SPECIAL REPORT

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PREFACE

The North Carolina Department of Natural Resources and Community Development (NCDNRCD) requested the Soil Conservation Service (SCS) to study alternatives for watershed protection in the Upper Neuse River Basin above Falls Dam at Falls, North Carolina. This study represents Phase VI of the Tar-Neuse River Basin Study.

Authorization for USDA participation in the study is provided in Section 6 of the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 566, as amended). This legislation authorizes the Secretary of Agriculture to cooperate with other federal, state, and local agencies in their investigation of watersheds and river basins to develop coordinated programs of resource use and management.

The Soil Conservation Service had overall responsibility for the study. Basically, this responsibility included the gathering, analyzing, reviewing, and preparating of data concerning soil and water related problems and the coordination of other agency input into a final report.

The Forest Service had the responsibility for providing: data, inventories, analyses, recommendations, and projections pertaining to forest resources.

The Economic Research Service (ERS) had the responsibility for compiling and analyzing statistics relating to the economic base of the study area. In addition, the ERS developed assessments of economic impacts of plans and alternatives.

SUMMARY

Purpose and Authority

This special report presents the results of a study of the Upper Neuse River Area of North Carolina conducted by the U. S. Department of Agriculture. The Soil Conservation Service, in cooperation with the Economic Research Service and the Forest Service, had overall responsibility for the study. The objectives of this study were to:

1. Identify the basic water and related land resource problems and concerns expressed by the people of the area;

2. Determine the magnitude and specific location of significant problems;

3. Forecast the effects of the problems on the area's natural resources;

4. Develop implementable alternatives for reducing soil and water resource problems; and,

5. Present implementable strategies for alleviating the basic resource problems.

Description of the Area

The Upper Neuse River Study Area is the Neuse River drainage area above Falls Dam at Falls, North Carolina, consisting of portions of Durham, Franklin, Granville, Orange, Person, and Wake Counties. The area covers 493,196 acres (almost 771 square miles). The Eno, Little, and Flat Rivers form the headwaters of the Neuse River which originates in eastern Durham County. The Neuse flows southeasterly into the Pamlico Sound and into the Atlantic Ocean.

Land use in the Study Area is 12 percent cropland (60,644 acres), 7 percent pasture and hayland (35,787 acres), 10 percent urban and residential (50,987 acres), 62 percent forest land (304,369 acres), and 9 percent other lands and large lakes (41,409 acres). Urban areas include Durham, Roxboro, Hillsborough, Creedmoor, and Butner.

Problems and Concerns

Problems and concerns of the Upper Neuse River Study Area are related to the improvement in the quality of life through development, protection, enhancement, and utilization of the water and land-related resources.

An evaluation of the problems resulted in the recognition of erosion and accompanying sedimentation as the most critical resource problem. About 84 percent of the area's 60,644 acres of cropland has an annual erosion rate in excess of acceptable soil loss limits. Sedimentation resulting from excessive erosion contributes to problems of infertile deposition, stream channel filling, and declining water quality and fishery resources.

Water quality of the Neuse River system continues to decline. The coastal estuary is experiencing eutrophication. Nutrients derived from the highly erodible soils of the croplands are major contributors to this problem.

Quality of the aquatic ecosystems is a major concern. Sediment accumulations have filled pool areas and disturbed the riffle-pool ratio to the point where a game fishery is almost nonexistent in most of the streams.

Prime and important lands being used for development purposes are becoming a concern and will be more so in the future as additional conversion to nonagricultural use occurs. In addition, excessive erosion is depleting the resource base of these important lands.

Wetlands, primarily beaver ponds, are largely unmanaged and the potential for managing with such practices as water level manipulation, food plantings, and duck box installation could have particular application.

Alternatives

Three alternatives for reducing the erosion and sedimentation problems have been developed. The first alternative is a continuation of the ongoing land treatment program. Alternatives 2 and 3 are directed primarily toward reducing agriculturally-related resource problems through the implementation of selected resource management systems under an accelerated program. Alternative 2 is concerned primarily with the more severely eroding lands only, while Alternative 3 would essentially reduce erosion on all lands to an acceptable limit of 5 tons per acre per year or less.

Implementation Strategies

Continued degradation of the soil resource base can result in significant yield reductions on cropland over the 40-year planning period. However, due to the necessity of short-term farm planning, it is difficult to justify expenditures now for resource management systems that result in such long-term benefits. According to a case study conducted in conjunction with this report (Appendix B), land treatment can result in a net loss of farm income within the short-term farm planning period of 3 to 5 years. Therefore, some type of economic incentive is apparently needed to offset the costs of implementation of any alternative.

Most of the elements of the three alternatives could be implemented with the assistance of a number of existing USDA programs. Nine implementation strategies are offered, each emphasizing protection and preservation of the resource base through establishment of land treatment measures.

INTRODUCTION

The Tar-Neuse River Basin Study, authorized by the United States Department of Agriculture in 1971, is a cooperative Federal-State undertaking to identify water and associated land resource problems and to develop alternative plans for solving these problems. The study was initiated at the request of the Governor of North Carolina to devise remedies for land and water resource problems through the implementation of programs to further the management and development of resources that will contribute most to improving the quality of life for all people of the Basin.

During the development of the Tar-Neuse River Basin Study, two problem areas having severe erosion and resulting high sediment damages were identified. These two areas, the Upper Tar (studied as Phase V) and Upper Neuse (studied as Phase VI), are among the most severely eroded areas in North Carolina. Consequently, several water quality problems exist, and there is potential for more serious problems in the future.

Phase VI of the study was undertaken to detail alternatives for solving the concerns of loss of resource base and water quality that have been identified in the area of the Neuse River above Falls-of-Neuse Reservoir.

Five concerns were identified for detailed study and evaluation in this report. These concerns are:

1. Preservation and protection of the resource base.

2. Improvement of water quality.

3. Protection of the fishery resource by maintaining minimum flow.

4. Identification, delineation, and protection of prime and important farmlands and forestlands.

5. Identification, delineation, and protection of wetlands.

The objective of this study was to develop implementable alternatives and strategies to address those concerns.

CHAPTER I

GENERAL SETTING

Location and Size

The study area is located entirely in north-central North Carolina (see Appendix A). The hydrologic area covers approximately 493,196 acres, or nearly 771 square miles, and encompasses portions of Durham, Franklin, Granville, Orange, Person, and Wake Counties. The Eno, Little, and Flat Rivers form the headwaters of the Neuse River which originates in eastern Durham County. The Neuse flows southeasterly into the Pamlico Sound and into the Atlantic Ocean. In Person County, streams of the Upper Neuse system flow over rocky shoals and some rapids. Stream flow in the lower part of the study area becomes somewhat sluggish. Elevations in the area range from about 800 feet in Person County to less than 220 feet near the Falls Lake Dam in northern Wake County (outlet of the study area).

Climate

The climate is characterized by warm summers and mild winters. Temperatures seldom drop below zero during winter, and occasionally reach or exceed 100°F during summer. Temperatures are affected by air masses that circulate over the Atlantic Ocean and by air masses that move up from the Southwest. The Appalachian Mountains, located west of the study area, form a partial barrier to the cold air masses moving southeastward from the interior of the country.

Rainfall averages about 47 inches. July and August are the wettest months with a rainfall of about five inches each. October, the driest month, has about half as much. The rainfall is fairly evenly distributed over the remaining nine months. Tropical storms occasionally cross the Basin. These storms yield heavy rainfall, and many are accompanied by strong winds. The eastern half of the Basin is most frequently affected.

Climate in the area is considered mild. Average annual temperature is 60°F. The average January temperature is 42°F, while the warmer July temperature is 78°F. The freeze-free period is about 200 days.

Soils

The Soil Conservation Service and the North Carolina State University have prepared maps of general soil associations for each county in the study area. These maps were used to prepare the General Soil Map of the Basin (see Appendix A). Soil associations occurring in the Upper Neuse are listed and described as follows:

> Cecil-Madison-Appling: Gently sloping, well drained, deep, clayey soils that have formed in residuum weathered from acid crystalline rocks in the Piedmont, and covers 13 percent of the area.

Wilkes: Hilly to steep, well drained, shallow loamy soils that have formed in residuum weathered from mixed acid and basic rocks on highly dissected narrow ridges and steep valleys in the Piedmont. Includes about 2 percent of study area.

Enon-Helena-Vance: Gently sloping, well drained and moderately well drained, moderately deep clayey soils that have formed in residuum weathered from acid or mixed acid and basic rocks in the Piedmont. This association is found on 20.6 percent of the area.

Iredell-Mecklenburg-Enon: Smooth to sloping, moderately well drained to well drained, moderately deep clayey soils that have formed in residuum weathered from mixed acid and basic rocks in the Piedmont, and covers 3.9 percent of the study area.

Mayodan-Granville-Creedmoor: Level to moderately steep, moderately well drained clayey soils that have formed in mixed basic and acid Triassic residuum. This association represents 0.2 percent of the area.

Helena-Appling-Vance: Gently sloping, well drained and moderately well drained clayey soils that have formed in residuum weathered from acid crystalline rocks, and covers 0.1 percent of the area.

Wehadkee-Chewacla-Roanoke: Soils on nearly level flood plains and low stream terraces. Moderately well drained to poorly drained loamy and clayey soils formed in recent acid alluvium washed from the Piedmont. Occur along Piedmont streams and may also occur along major streams and rivers that originate in the Piedmont and flow seaward through the Coastal Plain. Subject to very frequent flooding. This association represents 0.3 percent of the study area.

Lignum-Enon-Orange: Level to strongly sloping, moderately well drained and well drained clayey soils that have formed in residuum weathered from slate or acid and basic rocks in the Piedmont, and covers 0.1 percent of the area.

Chewacla-Wehadkee-Congaree: Soils on nearly level flood plains in Piedmont. Well drained to poorly drained loamy soils formed in recent acid alluvium washed from the Piedmont and mountains. Subject to frequent flooding. Represents 1.2 percent of the study area.

White Store-Creedmoor: Gently sloping to sloping, moderately well drained, deep, highly plastic soils with clayey subsoils formed in mixed basic and acid Triassic residuum. Covers 3.7 percent of the study area.

Georgeville-Tatum-Herndon: Gently sloping to sloping, well drained, deep and moderately deep, clayey soils that formed in residuum weathered mainly from slate in the Piedmont. This association is found on more than 25 percent of the study area.

Badin-Goldston-Wilkes: Hilly to very steep, well drained, shallow to moderately deep soils (covering only 0.1 percent of area) that have a slaty, loamy or clayey subsoil formed in acid slate or mixed acid and basic residuum.

Appling-Durham: Gently sloping to sloping, well drained, deep soils on 13.6 percent of study area. They have a clayey or loamy subsoil and have formed in acid granitic residuum on broad smooth slopes near the fall line.

Wedowee-Louisburg: Gently sloping to steep, well drained, deep soils that have a clayey or loamy subsoil formed in acid granitic residuum. Occur in valleys, side slopes, and narrow ridges. Found on 16 percent of area.

Orange-Vaucluse-Lillington: Nearly level to strongly sloping, moderately well drained soils on broad inner-stream areas and sideslopes covering less than 0.1 percent of the area.

Tatum-Goldston-Badin: Nearly level to steep, well drained slaty soils on ridges and sideslopes and covers 0.1 percent of the area.

Geology

A series of interbedded tuff, breccia, shale, slate, and schist, all locally called slate rocks, underlies the western two-thirds of the Basin. These rocks also include quartz veins and diabase dikes. Generally, they are tipped on end and trend northeastward. They are predominantly acidic in composition, but iron minerals have stained the weathered soil zone to brown or dark red. Jointing and shearing are common features within several hundred feet of the surface. The eastern one-third of the basin is underlain by granite and gneiss with some Triassic shales and sandstones.

Rocks of the Piedmont have been altered by various physical and chemical processes so that a moderately deep zone of reddish soil and soft decayed rock is characteristic of the region. The surface is rolling to hilly in many places, especially near the streams, but broad upland areas and long ridges are also common where the rocks are more resistant to erosion.

Land Use

Present land use in the Upper Neuse area is shown in the following table (also see Appendix A).

TABLE I-1
Land Use, 1982
Upper Neuse River Study Area, North Carolina

Land Use	Acres	Percent Total Area
Cropland	60,644	12
Pasture and Hayland	35,787	7
Idle Cropland	8,953	2
Urban/Residential	50,987	10
Large Lakes	23,367	5
Forest land	304,369	62
Other*	9,089	2
Total	493,196	100

*Includes: Rural residences, farmsteads, small bodies of water, roadsides, streambanks, construction sites, etc.

Population

Urban areas within, or partially within, the study area and their approximate 1980 populations are: Durham (100,800), Roxboro (7,500), Hillsborough (3,000), Creedmoor (1,600), and Butner (4,200). Raleigh (150,000) is located about 15 miles south of Falls Reservoir.

Forest Inventory [1/]

Forest land comprises 62 percent (304,369 acres) [2/] of the study area (Figure I-A) and consists of five basic forest types: pine (loblolly-shortleaf), 33 percent; upland hardwoods (oak-hickory-poplar), 35 percent; pine-hard-woods (pine-oak-poplar), 17 percent; bottomland hardwoods (oak-gum-cypress), 10 percent; and other hardwoods (elm-ash-cottonwood), 5 percent. Over 99 percent of the forest land is classified as commercial. The remaining one percent is classified as productive reserve and is not available for commercial utilization. The inventory of growing stock is approximately 443.3 million cubic feet.

Farmers and other private individuals (55 and 30 percent) are the major owners and basically control use and management of the forest resources. There are no national forest lands in the Basin. Logging and pulpwood operations on about 12,500 acres remove approximately 63.8 million board feet of sawtimber and about 83.5 thousand cords of pulpwood annually. This is equivalent to 18.1 million cubic feet of growing stock.

1/ Source: "Forest Statistics for the Piedmont of North Carolina. 1975," USDA Forest Service Resources Bulletin SE-32. Data combined for Durham, Granville, Orange, Person, and Wake Counties.

2/ Based on digitized land base.

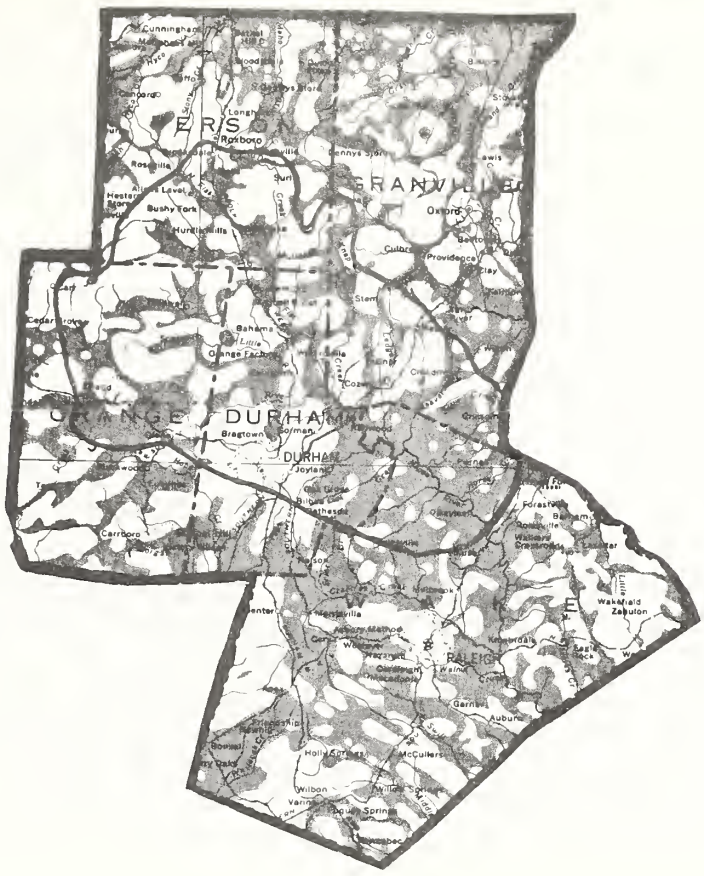


Figure I-A. Generalized forest cover of five-county forest area with basin area delineated.

CHAPTER II

PROBLEMS AND CONCERNS

Introduction

Problems and concerns of individuals the study area are related to the improvement in the quality of life through development, protection, enhancement, and utilization of the water and land-related resources. Changes in resource use and management are taking place within the area because of the demands placed upon the resources. The people of the State of North Carolina are concerned that the changes being made should be anticipated, considered, and brought about in an orderly manner. Concerns of the people have been expressed by members of various organizations, interested groups, and individuals and are as follows:

1. Preservation and protection of the resource base -- Severe erosion has caused a drastic decrease in crop yields. On some fields, the soil resource has been completely depleted.

2. Improvement of water quality -- Water quality degradation from sediment deposition is affecting fish populations in the streams. Concerns have been expressed for lost capacities in reservoirs and streams. Nutrient content derived from the Tar-Neuse drainage area has contributed to eutrophication in the lower Neuse River and Pamlico Bay.

3. Protection of the fishery resource -- Minimum in-stream flow requirements are needed to maintain a fishery resource. A reduction in sediment delivery is needed to benefit the fishery resource.

4. Identification and delineation of prime and important farmland and prime forest land, and

5. Identification and delineation of wetlands -- Site specific identification and delineation of these lands are needed to assist local planners and conservation districts in setting priorities for local projects and programs.

Erosion and Sedimentation

Erosion is a complex, natural process that cannot be completely halted. It is more profoundly affected by man's activities than by natural processes. However, erosion can be controlled to within acceptable limits with sound land use and installation of conservation practices.

Gross erosion in the Upper Neuse River study area amounts to about 886,987 tons annually (see Appendix A). Approximately 65 percent, or 578,189 tons, of the total erosion in the Basin is sheet and rill erosion from cropland. Pasture and hayland, forest land, idle lands, urban and residential areas, roads and streams, and other lands

Soil erosion on cropland in the study area averages greater than 9.5 tons per acre per year.

60,000 acres of cropland produce almost 600,000 tons of erosion annually.

contribute the remaining 35 percent, or 308,798 tons. Gross erosion by land use is presented in Table II-1 and Figure II-A (also see Appendix A).

Gross erosion from more than 83 percent of the land is less than 5 tons per acre per year (Table II-2). Almost 29 percent of present soil erosion originates from these lands considered to be adequately treated. Erosion rates greater than the 5 ton level exceed the soil loss tolerance for most soils. This level represents the maximum rate of soil erosion that will still permit a high level of crop production to be sustained economically over a long period of time. Most of the land in the 0-5 ton per acre per year erosion group is forest land. Toward the other end of the erosion continuum where erosion is 12 tons or more per acre per year, only 3.6 percent of the land is associated with about 33 percent of present soil erosion. Most of this land is in crop production.

TABLE II-1
Gross Erosion by Land Use, 1982
Upper Neuse River Study Area, North Carolina

Land Use 1/	Acres	Tons (Annually)	T/Ac/Yr (Average)	Percent Total Erosion
Cropland	60,644	578,189	9.52	65
Pasture/Hayland	35,787	120,102	3.35	13
Idle Cropland	8,953	35,017	3.91	4
Forest land (Disturbed)	21,593	25,351	1.17	3
Forest land (Undisturbed)	282,776	Insignificant	--	--
Urban/Residential	50,987	68,132	1.34	8
Other	9,089	60,196	6.62	7
Total 2/	469,829	886,987	--	100.0

1/ Other includes rural residences, farmsteads, roadsides, streambanks, etc.
2/ Does not include 23,367 acres in large lakes.

Erosion exceeding acceptable limits occurs on over 51,000 acres of cropland in the Upper Neuse Basin.

More than 16,000 acres of cropland are eroding greater than 12 tons per acre per year.

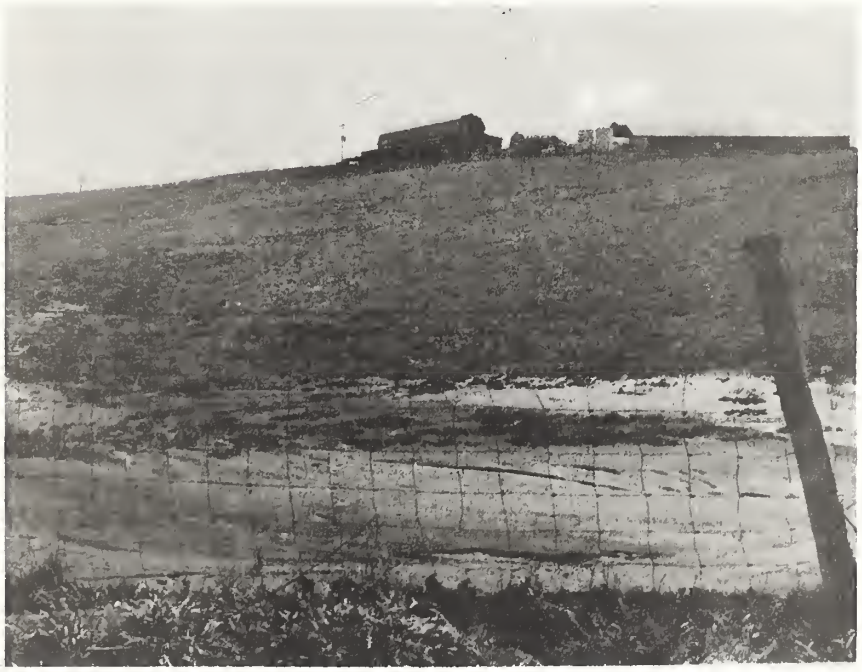
TABLE II-2
Acreage and Soil Erosion by Land Use and Soil Erosion Groups, 1982
Upper Neuse River Study Area, North Carolina

Existing Erosion Rate (t/ac./yr.)	Land Use [1]	Acres	Present Soil Loss (t/yr.)
0-5	Cropland	9,532	28,554
	Pasture/Hayland	33,006	99,012
	Idle Cropland	7,029	21,087
	Forest land (Disturbed)	21,593	25,351
	Forest land (Undisturbed)	282,776	Insignificant
	Urban/Residential	50,870	67,137
	Other	6,795	15,933
	Total	411,601	257,074
	(Percent)	(83.4)	(28.9)
5-8	Cropland	16,434	106,724
	Pasture/Hayland	2,201	14,307
	Idle Cropland	1,596	10,374
	Forest land	-	-
	Urban/Residential	73	475
	Other	991	3,911
	Total	21,295	135,791
	(Percent)	(4.3)	(15.3)
8-12	Cropland	18,546	185,596
	Pasture/Hayland	461	4,609
	Idle Cropland	264	2,640
	Forest land	-	-
	Urban/Residential	24	240
	Other	781	5,721
	Total	20,076	198,806
	(Percent)	(4.1)	(22.6)
12-16	Cropland	9,860	138,474
	Pasture/Hayland	10	147
	Idle Cropland	59	826
	Forest land	-	-
	Urban/Residential	10	120
	Other	356	5,532
	Total	10,295	145,099
	(Percent)	(2.1)	(16.4)
16-20	Cropland	5,032	90,878
	Pasture/Hayland	93	1,674
	Idle Cropland	5	90
	Forest land	-	-
	Urban/Residential	10	160
	Other	138	2,703
	Total	5,278	95,505
	(Percent)	(1.1)	(10.8)
> 20	Cropland	1,240	27,963
	Pasture/Hayland	16	353
	Idle Cropland	-	-
	Forest land	-	-
	Urban/Residential	-	-
	Other	128	26,396
	Total	1,384	54,712
	(Percent)	(0.3)	(6.2)
	Total [2]	469,829	886,987
	(Percent)	(95.3)	(100)

1/ Other includes rural residences, farmsteads, roadsides, streambanks, construction sites, etc.

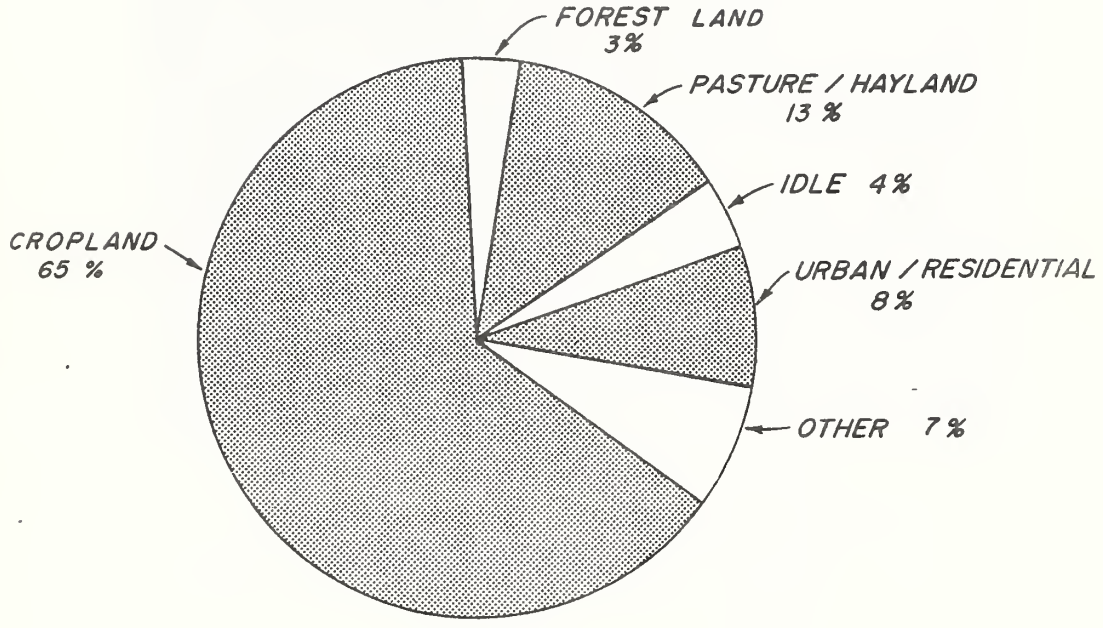
2/ Does not include 23,367 acres (4.7%) in large lakes.

Critical erosion on this pastureland exceeds 30 tons per acre per year.



Erosion on pasture and hayland in the Upper Neuse Basin amounts to over 120,000 tons annually.

FIGURE II-A
Percent Gross Erosion by Land Use, 1982
Upper Neuse River Study Area, North Carolina



Cropland is the largest single contributor to the erosion and sedimentation problem in the area (Figure II-A). Major causes of cropland erosion are the lack of conservation systems or inadequate conservation practices. Of the 60,644 acres of cropland, approximately 16 percent, or 9,532 acres are considered adequately treated; i.e., eroding less than five tons per acre annually. The remaining 51,112 acres eroding in excess of the soil loss tolerance contribute about 549,635 tons annually to gross erosion and are of major concern. Cropland erosion rates are presented in Table II-4.

Erosion from 35,787 acres of pasture and hayland amounts to approximately 120,102 tons annually. Of this amount 21,090 tons are produced from about 2,781 acres eroding in excess of the soil loss tolerance for an average of 7.6 tons per acre per year. Excessive erosion on pasture and hayland results from overgrazing and/or improper fertilization on steeply sloping land.

Forest land erosion occurs mainly as a result of activities associated with timber harvest and reforestation operations. Most erosion problems occur during logging, windrowing, very heavy site preparation, and in connection with lack of maintenance on skid trails and log roads.

Severe erosion occurs on about 350 acres of streambanks in the Upper Neuse system.

Nine percent of the streambanks contribute over 200 tons per acre of sediment directly to the basin's streams annually.

Table II-3 depicts effects of various silvicultural and other related forestry factors.

As shown on Table II-2 erosion from other land (including urban and residential, farmsteads, land under development, etc.) is generally within the soil loss tolerance. Isolated areas, such as construction sites, mines and/or borrow pits usually have excessive erosion rates. Roadside erosion occurs on 559 acres and totals 9,168 tons per year, while 338 acres of streambanks are eroding 15,920 tons annually. Ten percent of the roadsides is producing almost 40 percent of the erosion

TABLE II-3
Forest Land Erosion 1/
Upper Neuse River Study Area, North Carolina

Forest Factors	Acres	Tons (Annual)	Tons/Acre (Average)
Logging	12,500	2,250	0.18
Skid Trails	500	90	0.18
Log Roads	250	12,500	50.00
Root Rake	875	3,400	3.90
Roller/Chop	1,750	350	0.20
Chop/Burn	1,750	700	0.40
KG Blade	3,500	6,000	1.70
Burn	300	39	0.13
Fire	168	22	0.13
Total	21,593	25,351	1.17

1/ Source: Tar-Neuse River Basin Report

Critical roadside erosion exceeds 100 tons per acre per year.

Severe erosion occurs on over 1,150 miles of roadbanks in the study area.

TABLE II-4
Cropland Erosion Rates by Crops, 1982
Upper Neuse River Study Area, North Carolina

Crop	Acres	Tons of Erosion (Annually)	Tons/Acre (Average)
Small Grain	9,755	62,536	6.41
Corn	15,932	166,930	10.50
Tobacco	19,158	200,979	10.49
Soybeans	12,755	126,649	9.93
Sorghum	1,456	12,672	8.70
Grass Crop Rotation	1,406	7,338	5.22
Truck Crops	182	1,085	5.96
Total	60,644	578,189	9.53

at a rate of 82 tons per acre per year. Nine percent of the streambanks is contributing 66 percent of the total at more than 200 tons per acre annually.

Water Quality

Water quality is of vital concern in the Upper Neuse River Basin. In order to ensure public health, these waters must have high water quality on a sustained basis.

In 1976, the Triangle J Council of Governments indicated the majority of tributary streams in the Upper Neuse Basin needed additional treatment beyond secondary treatment of municipal sewage and best-practicable-technology treatment of industrial waste water in order to return the streams to fishable and swimmable conditions. 3/ Compounding these conditions is the influx of sediment from agricultural areas. These sediments cause adverse affects in two ways - the actual deposition of soil materials can be harmful to stream biota, and the agricultural chemicals (nutrients and pesticides) which are attached to sediment particles further deteriorate water quality. Recent discussions with the Division of Environmental Management (DEM) indicate these conditions have not changed significantly since 1976. These factors affecting water quality conditions could restrict the optimal use of the recently constructed Falls Reservoir for recreation and water supply.

3/ Water Quality of North Carolina Streams, U.S. Geological Survey, Water-Supply Paper 2185 A-D, pages D-2, D-3.

The Basin encompasses approximately 493,196 acres. Some 21 percent, or 105,384 acres, is in agricultural use, including cropland, pasture and hayland, and idle cropland. Water runoff from these areas often has high loadings of sediments and agricultural chemicals. Urban areas account for 10 percent, or approximately 50,987 acres. Due to high erosion and sedimentation rates during construction, these areas are also principal sources of sediment delivered to basin waters.

Forest land is a major contributor of high quality water yield in the Basin. Undisturbed forest land yields between 12-16 area inches annually. Timber harvesting affects an increase in normal water yield of 1-1½-area inches as removal of the forest canopy reduces or eliminates evapotranspiration, especially during the spring and summer months. This additional yield, however, is not apparent in the Basin because of clogged channels.

The annual sediment contribution is estimated to be approximately 257,150 tons, most of which is generated by cropland erosion. Annual erosion on cropland areas is 578,189 tons. Total erosion from all areas is 886,987 tons annually. Small tributaries in the Basin are the major "receiving waters" for the sediment due to physical proximity to the sources. However, accumulative processes from the smaller tributaries can be expected to adversely affect water quality in major tributaries, the Upper Neuse River, and impoundments in the Basin.

Fishery Resource

A major concern is the quality of aquatic ecosystems. The water quality is being deteriorated by excessive erosion, particularly streambank erosion which contributes up to 200 tons per acre per year. Deposition resulting from this erosion has filled pool areas and disturbed the riffle-pool ratio. Sediment accumulation is affecting the game fishery, and in some streams, rough fish predominate. Recently deposited sediments are unstable and cause shifting sand which is not conducive to supporting good game fish populations. Food organisms for fish are almost nonexistent in the shifting sands. Sediment deposition also damages the aesthetic quality of the stream system.

Land Use, Including Prime and Important Lands

Levels of soil erosion and sedimentation in the study area are directly related to present uses of land. These land-use decisions are made individually by a large number of landowners and(or) tenants and largely independently of public concerns about resource use. These public concerns include reducing soil erosion to help maintain long-term productivity of the resource base and to lessen sedimentation on land and in water. Protection of prime agricultural land and other important lands from conversion to nonagricultural uses is of concern particularly in areas of urban growth.

Sediment deposition has destroyed a major portion of this corn crop.

Sediment, resulting from upland cropland erosion, has filled the downstream watercourse.

Individual landowners tend to be concerned with present and near-term economic conditions and make land-use decisions accordingly. Consequently, decisions based on individual goals are not necessarily consistent with public goals.

Some conversions in land use are occurring. When forest or pasture is converted to cropland, higher levels of soil erosion result. Most newly converted lands will require some land treatment in order to protect soil productivity. Prime agricultural lands are also prime for most nonagricultural uses. Conversion to nonagricultural uses tends to be irreversible. The public generally prefers some orderly conversion where losses of prime lands for agricultural uses are minimized. Higher prices for land, higher taxes, and uncertainty about future economic developments can encourage conversion to nonagricultural uses and(or) discourage investments in the farming operation eventually leading to lower farm production and idling of farmland.

The number of farms and land in farms for the four major counties included in the study area[4/] have declined substantially during the 1964-78 period (Table II-5). The size of the cropland base, however, has remained about the same. Reductions of land in farms have been offset by conversions of woodland to crop production. Average farm size has increased by about 27 percent during this period. The four county share of agricultural land in North Carolina has remained stable over 1964-78.

Nationally, as well as locally, there is concern about the amount of agriculturally productive land available for producing food and fiber in the future. Prime farmland has the soil quality, growing season, and moisture for producing high yields of crops over time when treated and managed, including water management, according to modern farming methods. Excessive erosion is depleting the resource base of these important lands.

Conversions in land use are occurring almost daily. Based on observation and field investigations of 1981 photography in conjunction with 1973 and 1978 orthophotoquads, approximately 24,500 acres of commercial forest land have been converted to other uses.

The largest single conversion was the development of the Falls-of-the-Neuse Reservoir. Approximately 12,500 acres of bottomland forest were eliminated from forest land inventory to provide Basin residents the amenities of high quality water plus the potential recreational benefits of swimming, boating, sailing, water skiing, camping, fishing, and other benefits that make up the quality of life experience. The total volume of timber resources removed from the reservoir area and the forfeited annual growth for 100 years would have sustained the Basin hardwood industries for 30 years.

4/ Historical data for the Upper Neuse portion of the four county area are not available.

TABLE II-5 Number of farms, land use within farms, and average farm size for counties in the Upper Neuse River area and percentages of North Carolina, 1964-78 1/

	1964	1969	1974	1978
Number of farms	5,650	4,540	3,370	3,030
Total land in farms (1,000 ac.)	676.7	577.0	480.9	460.4
All cropland (1,000 ac.)	199.2	205.8	186.7	191.1
Harvested cropland (1,000 ac.)	116.0	93.8	105.5	99.1
Cropland for pasture (1,000 ac.)	21.8	47.8	44.8	44.4
Other cropland (1,000 ac.) 2/	61.4	64.9	36.3	47.6
Woodland, including woodland pasture (1,000 ac.)	398.6	279.2	216.4	214.3
Other land (1,000 ac.)	78.9	92.0	77.8	55.0
Average size of farm (ac.)	119.8	127.1	142.6	151.9
	------- Percent of State -------			
Number of farms	3.8	3.8	3.7	3.7
Total land in farms	4.7	4.5	4.3	4.2
All cropland	3.4	3.4	3.2	3.2
Harvested cropland	2.9	2.7	2.6	2.2
Cropland for pasture	3.6	4.2	4.1	4.8
Other cropland	5.1	4.7	6.3	7.3
Woodland, including woodland pasture	5.8	5.5	5.4	5.5
Other land	4.5	5.4	5.4	5.1
Average size of farm	123.5	118.8	115.9	112.9

1/ Data for Durham, Granville, Orange and Person Counties only. Relatively small portions of Franklin and Wake Counties are included in the study area. Because of changes in definitions and procedures, data are not strictly comparable among census years.

2/ Land in soil improvement crops, land on which are crops failed, and cropland idled.

3/ Pastureland and rangeland other than cropland and woodland pasture plus land in farmsteads, ponds, roads, and wasteland.

Source: Bureau of the Census. Census of Agriculture.

Conversion of wood to agriculture is presently occurring at the rate of about 400 acres per year. For the period 1973-1977, the rate was 130 acres per year. For the period 1977-1981, the rate increased about three and one-half times. Most acreage conversions are small, one or two acres here and there. This type of conversion is appropriately called "field aligning" where the farmer squares off his field for efficient use of equipment. The largest conversions involve acreages amounting to over two hundred acres. Intensive land clearing was involved and erosion was severe.

Bottomland hardwoods are particularly susceptible to water resource development. When a new subdivision is needed, pine lands give way. The same is true when woods are converted to trailer parks, shopping centers, transmission lines, rural power and telephone line, and crop and pasture land. Approximately 2,800 acres of forest land, mostly in pine, is occupied by single or multiple mobile homes in the area. Single mobile homes occupy from one to one and one half acres and are usually found along secondary highways, and are more or less of a permanent nature (foundations).

Approximately 80 percent of the commercial forest land is considered prime timberland. This designation is related to the character of the predominant soils in the area.

The supply and quality of the timber resource depends on the productiveness of the site. Forest cover must remain on the most productive sites for the 20 to 100 years to produce products needed in the future. If timber production is relegated or confined to poor sites with correspondingly poor soils capable of growing only trees of inferior quality at a slow rate, then forest production will not be able to meet the future demand for timber and wood products.

Comparisons of the 1964 and 1974 Forest Service statistics reveal the following land use changes for the 6-county forest area:

a. a 27,020 acre loss (976,530 to 949,510 acres) in commercial forest land acreage

b. a 5,689 acre net increase in state ownership (12,909 to 18,598 acres)

c. a 3,723 acre net increase in county and municipal ownership

d. a 5,046 acre net increase in forest industry ownership (18,248 to 23,294 acres)

e. a loss of 141,981 acres (668,128 to 526,147 acres) in farmer ownership

f. a net gain of 99,825 acres (0 to 99,825 acres) in miscellaneous/corporate ownership

g. a net gain of 25,461 acres (249,193 to 274,654 acres) in private ownership

h. a net loss of 18,876 acres (23,025 to 4,149 acres) in federal ownership.

Approximately 3,500 acres of forest land were diverted to high tension transmission lines (21 acres per mile), low voltage lines (9 acres per mile), rural telephone and electric lines (2 to 2½ acres per mile) between 1978 and 1981. Shifts will continue to occur in the farmer-owned and private individual ownerships as farmers increase their holdings for economic operations. Federal holdings have increased while holdings by farmers and other private owners have declined due to construction of the Falls-of-the-Neuse Reservoir. Forest industry holdings are expected to increase slightly over the next decade because of favorable federal tax structures and investment opportunities. State, county-municipal ownership is expected to remain relatively stable.

As cropland becomes depleted by erosion and over-cropping a portion of the depleted land will become available for reforestation. In the long run, no major shifts in commercial forest land acreage are anticipated. However, the conversion of forest land to crop production through the year 2020 will involve approximately 16,000 acres of prime timberland. Conservation efforts could be increased to offset this loss by planting at least an equal number of acres of abandoned, marginal, or depleted cropland to trees.

Wetlands

Wetlands found in the study area are basically associated with beaver ponds and are type 3 5/ and 4 6/ wetlands depending largely on the depth of the water and age of the pond. These wetlands are scattered throughout the area and provide good to excellent wetland wildlife habitat.

Beaver ponds are largely unmanaged. Resource values associated with them are also unmanaged and species populations are dependent on seasonal variability of factors such as rainfall and temperature. The potential for managing these wetlands is excellent. Practices such as water level manipulations, food plantings, duck box installation, and selective clearing have particular application.

Beavers occupying lowland sites along small streams are common. The flooded areas back onto cropland, highway rights-of-way and wetland forests. While causing some damage to forest and cropland, some flowages pose a threat to county roads during periods of high water. Beaver flowages in the uplands occur along stream courses between the undulating hills and are primarily associated with a forest environment. Flowages occupy from one to five acres usually at a natural flow barrier such as a rock outcrop. Trees are usually killed in the main flowage while border species remain alive. Flooded areas provide excellent habitat for a variety of song birds and woodpeckers as well as mammals and amphibians.

5/ Inland shallow fresh marsh (Circular 39, USFWS)

6/ Inland deep fresh marsh (Circular 39, USFWS)

Social and Economic Factors Affecting Resource Use 7/

Several factors affect landowner's and/or managers decisions for resource use which, in turn, affect the types and severity of problems with soil erosion and sediment delivery. Individuals must first be aware of a problem before taking any action. Individuals with short planning periods and needing immediate economic returns tend to be less interested in land treatment systems which have current costs but usually do not provide economic returns until several years into the future. Also, those with short-term leases and/or leases that do not include provisions for landlord-tenant sharing of treatment costs would tend to be less interested in installing soil conservation practices. Some in this latter group are likely interested in extracting the most returns from the land while they operate it and they are not concerned with effects on future soil productivity. In 1978, about 56 percent of all farmers in the four county area were involved in some type of rental arrangement; 41 percent were similarly involved in 1974. 8/ These farmers operated about three-fourths of the harvested cropland in 1978, two-thirds in 1974.

Population is increasing in the study area. Growth during the 1970-80 period was about 22 percent compared to about 13 percent during 1960-70. 9/ More people require more water. Some of the land converted to nonagricultural uses is prime agricultural land.

Individuals must be aware of erosion and sedimentation problems before making land use changes. About half of those participating in a survey of landowners and operators in the Upper Tar indicated having a problem with soil erosion. The proportion of full-time farmers indicating an erosion problem was higher than part-time farmers and those not doing any farming. Full-time farmers operate relatively more land resulting in more possibilities for erosion. They may also be more aware of the occurrence of erosion. The trend during the 1970's was toward more farmers spending more work days off the farm.

Planning assistance provided by SCS conservationists results in the development of farm conservation plans which are instruments used for installing systems of conservation practices. About two-thirds of those in the Upper Tar survey were familiar with farm conservation plans developed by SCS. Full-time farmers and those associated with larger acreages were relatively more familiar. Only 40 percent had plans for the land they owned and/or operated. Larger-scale operators had plans more often. Farm size, however, is not necessarily related to the occurrence of problems with erosion.

7/ Portions of this section are based on results of a mail survey of landowners in the Upper Tar River area adjacent to the Upper Neuse study area. This survey was conducted by the North Carolina Department of Natural Resources and Community Development in 1981. Also, interviews of landowners were conducted by SCS personnel.

8/ Bureau of the Census. 1978 Census of Agriculture. North Carolina.

9/ Bureau of the Census. 1980 Census of Population.

Most of those participating in the Upper Tar survey were also involved in leasing land. Current leasing arrangements are not conducive to implementing land treatment practices. Only 30 percent of those surveyed had leases for a specific time period. These were short-term leases, usually for one year. However, over half rented to or from the same individual for five years or longer thereby providing some stability to leasing arrangements. Provisions for landlord-tenant sharing of the costs of installing conservation practices were included in less than 10 percent of the leases. Those renting relatively larger tracts of land were no more likely to have a cost-sharing provisions included in their leases than smaller-scale renters. There also was no correspondence between having a cost-sharing provision and length of the lease. When asked what changes in their lease would encourage them to install conservation practices, the need for longer lease -- 2 to 5 years -- was mentioned most often. In addition, others felt owners should share more of the installation costs.

Even if individuals are aware of problems, have sufficiently long planning periods, and have tenure arrangements conducive to implementing land treatment practices, they must have the economic capability to underwrite costs of the practices. Cost-sharing and technical assistance through USDA programs add to this economic capability of individuals. However, cost-sharing may not be adequate to induce voluntary conservation. Farms are relatively small in the four county area. In 1978, about 36 percent of the farms were less than 50 acres of size; three-fourths were less than 180 acres. 10/ This size distribution was similar to that of 1974.

Recent reductions in the cost-share program in forestry will have effects on the amount of forestry activity in the area. However, recent federal taxation changes provide a good incentive for forest owners to plant their idle acres.

Partly related to farm size is the value of agricultural products produced. In 1978, about 45 percent of farms in the four country area had sales totaling less than $10,000. About 55 percent of the farms had sales of that magnitude in 1974. Levels of sales must also be viewed in the context of time spent farming. In 1978, about half of the farmers reported working off the farm. About one-third indicated such work for over 150 days compared with 25 percent in 1974. 11/

Among those in the Upper Tar survey with soil erosion problems, the most frequent reasons for lack of action were that installation was too costly and levels of cost-sharing for installation were too low. Also, they felt they had to use available monies for other farming and living expenses. Uncertainty of renting land from year to year and landowner-tenant reluctance to share installation costs were also mentioned.

10/ 1978 Census of Agriculture

11/ 1978 Census of Agriculture

Capacity to pay for land improvements and implementation of conservation practices must be examined in the context of profits from farming, off-farm income, obligations for operating and living expenses, mortgage payments, and so on. This capacity will vary with farm operation and household and is not necessarily related to the incidence and severity of soil erosion problems. Even for those implementing practices, maintenance of the measures over time will be affected by this combination of social and economic factors.

CHAPTER III

FORECASTING RESOURCE CONDITIONS

On-Site Effects of Erosion

Both short- and long-term adverse impacts occur when erosion and soil loss from land in agricultural production is greater than tolerance levels. Short-term adverse effects are mainly associated with increased production costs. Operations such as land smoothing and filling and shaping gullies prior to planting and, in many cases, again prior to harvesting increase costs. Other short-term effects include poor seed germination, difficulty in cultivation, loss of crops from sediment deposition, and loss of fertilizer. Long-term effects are primarily related to limited yield potential of the soils below the productive layer. Continued excessive erosion will further deplete soil resources and will reduce the probability of long-term sustained production levels. Soils of the study area are particularly susceptible to damage because of slope, past erosion, and the lack of adequate conservation treatment and management measures.

Man's activities, predominantly in agriculture, have accelerated soil erosion. Severe sheet and rill erosion on cropland and to a lesser extent, on pasture, is causing a serious and rapid deterioration of the soil resource base. Critical economic losses and serious sedimentation of the area's streams, ponds, and lakes are related damages. Gully erosion, roadbank, streambank, and non-agricultural erosion are problems of much less significance to maintaining productivity of the resource base.

Field runoff is presently being monitored on two sites in northern Wake County for a special water quality research and demonstration project. The project is being coordinated through North Carolina State University Department of Biological and Agricultural Engineering as a portion of the state's Agricultural Nonpoint Source Control Program. One site represents conditions of severe soil loss potential where continuous soybeans are planted straight up and down on a 5 to 10% slope. Runoff is being analyzed for sediments, nutrients, and organic matter. The final results of this project will be published in August, 1983 and can provide a basis for predicting the actual effects of erosion on yields and production costs for similar sites within the Upper Neuse Basin. In addition, results will indicate actual field losses of sediment transported in water runoff.

For purposes of describing problems with sheet and rill erosion, the concepts of soil erosion phase, erosion phase changes, and "phase change equivalents" will be used. A soil erosion phase quantifies the average depth of topsoil at the time of measurement or under present conditions. Soils in the study area are described in three phases. Phase I soils are those soils with an average topsoil depth of 6 inches or greater. Only 2,826 acres of phase I soils were identified during the assessment (see Table III-1), of which 1,095 are cropland.

Phase II soils have a topsoil depth of 3 to 6 inches (average 4.5 inches). About 93 percent (55,251 acres) of the cropland is comprised of phase II soils, and the average depth of topsoil is approximately 4.5 inches. Actual topsoil depth within a field will vary, but these phases reflect the average condition or depth.

Phase III soils have a topsoil depth of 3 inches or less. There are 4,298 acres of these soils in cropland within the study area.

An erosion phase change is defined as a change in topsoil depth from one phase to another and occurs when 1.5 inches of topsoil are removed by erosion from phase I and phase II soils. The removal of 1.5 inches of soils in this area is equivalent to 225 tons of erosion. Soil depletion occurs as a result of sheet and rill erosion and ephemeral gully erosion. While not all the soil moved, as estimateded by the soil loss equation, is lost or depleted, there is a significant, but unmeasured, amount of soil lost or depleted from ephemeral gully erosion. Soils in phase III do not undergo a phase change when 1.5 inches of topsoil are removed due to the definition of phase III having 3 inches or less of topsoil. However, a deterioration is occurring on phase III soils as parts of the remaining 3 inches or less of remaining topsoil are eroded. Yields on phase III soils are also affected by loss of topsoil.

Phase change equivalents are defined as the amount of topsoil loss necessary to move that soil into the next phase. This occurs on one acre when 1.5 inches of topsoil are lost. Phase change equivalents are not limited to only one acre and do not, as a rule occur abruptly, but as incremental losses with each eroding rainfall. 12/ The time required to cause a phase change depends upon the erosion rate of the soils and depth of topsoil. For example, a phase change equivalent occurs when each of 10 acres lose 22.5 tons of soil. The effects of this loss are cumulative and are distributed over the 10 acre area losing .15 inch rather than over one single acre losing 1.5 inches. Table III-1 shows current (1982) erosion phases.

Approximately 65 percent of the total erosion in the area is sheet and rill erosion from cropland. The 578,189 tons of annual soil loss from cropland is the amount of soil loss needed to cause an erosion phase change equivalent on 2,570 acres. At this erosion rate, in about 32 years, enough soil will have eroded from the cropland in the study area to cause an erosion phase change on each acre being used as cropland in 1982 (see Figures III-A, III-B, and III-C).

Of the total 60,644 acres of cropland, only 9,549 acres were assessed as needing no conservation treatment. Almost 52,000 acres need some degree of conservation treatment to help control sheet and rill erosion.

Sheet and rill erosion is occurring on pasture and hayland due to the lack of adequate pasture management. There are 35,787 acres of pasture and hayland in the study area. Of this total, 33,006 acres have good stands, are well managed, have very low erosion rates, and need no additional treatment.

12/ Farmland or Wasteland. R. Neil Sampson, Rodele Press, PA. 1981

In about 100 years, an erosion phase change will occur on each equivalent acre of cropland in the basin if current erosion rates are allowed to continue.

Because of severe erosion, 98 percent of the areas cropland has less than 6 inches of topsoil remaining.

TABLE III-1
Openland Erosion Rates and Erosion Phases (Existing Conditions), 1982
Upper Neuse River Study Area, North Carolina

Land Use	Acres	Erosion Rate (t/ac./yr.)	Gross Erosion (t/yr.)	Phase I (>6" Topsoil) Acres	Phase II (3"-6" Topsoil) Acres	Phase III (<3" Topsoil) Acres
Small Grain	9,755	6.41	62,536	124	9,135	496
Corn	15,932	10.50	166,930	313	14,138	1,481
Tobacco	19,158	10.49	200,979	475	17,483	1,200
Soybeans	12,755	9.93	126,649	121	11,569	1,065
Idle Cropland	8,953	3.91	35,002	289	8,290	374
Other Crops 1/	3,044	6.93	21,095	62	2,926	56
Pasture/Hayland	35,787	3.35	120,102	1,442	34,148	197
Total	105,384	--	733,293	2,826	97,689	4,869

1/ Includes sorghum, truck crops, grass/crop ration, etc.

FIGURE III-A
Upper Neuse River Study Area, North Carolina
Cropland Erosion Phase I Change Projection (Without Treatment)

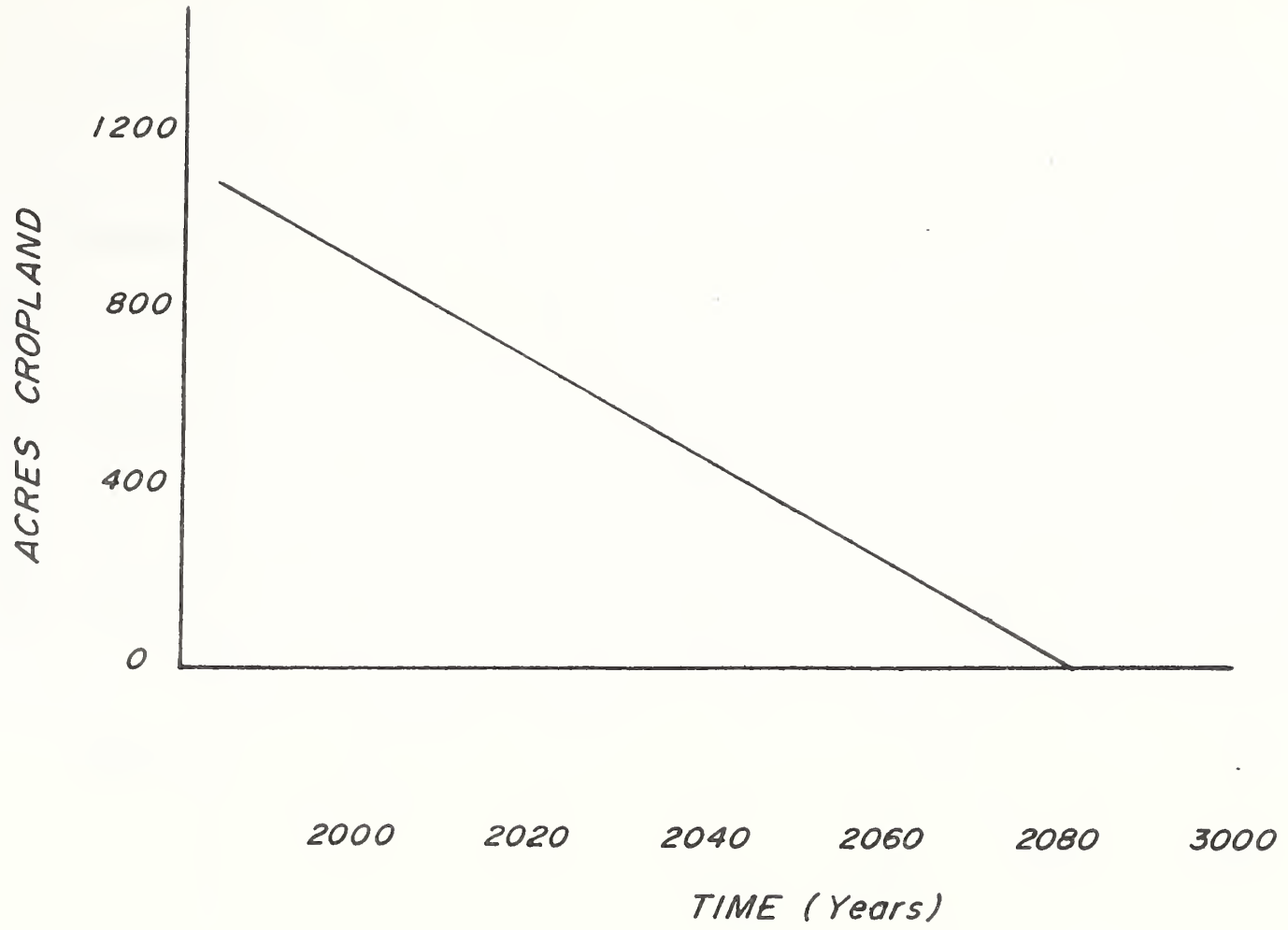


FIGURE III-B
Upper Neuse River Study Area, North Carolina
Cropland Erosion Phase II Change Projection (Without Treatment)

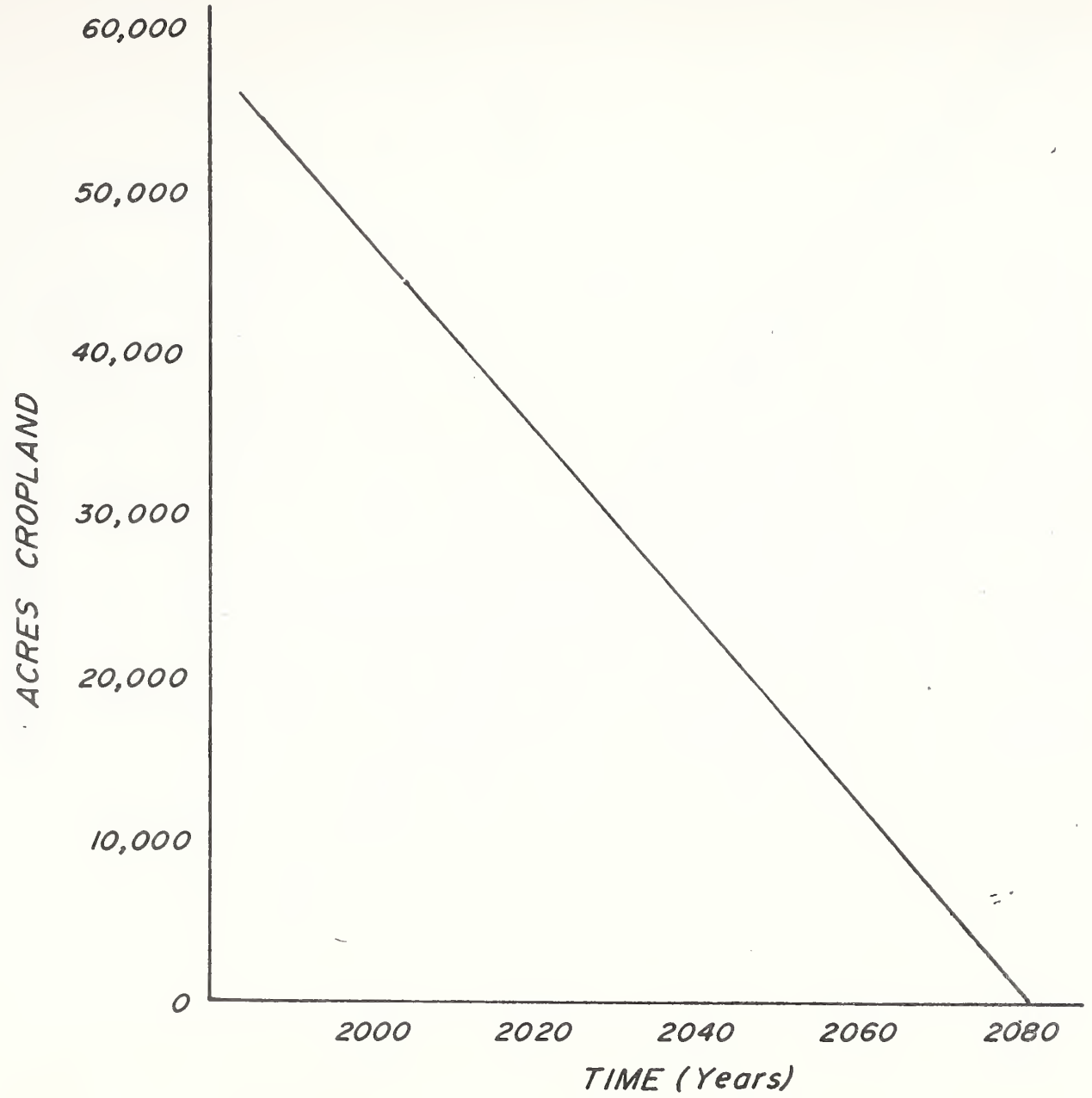
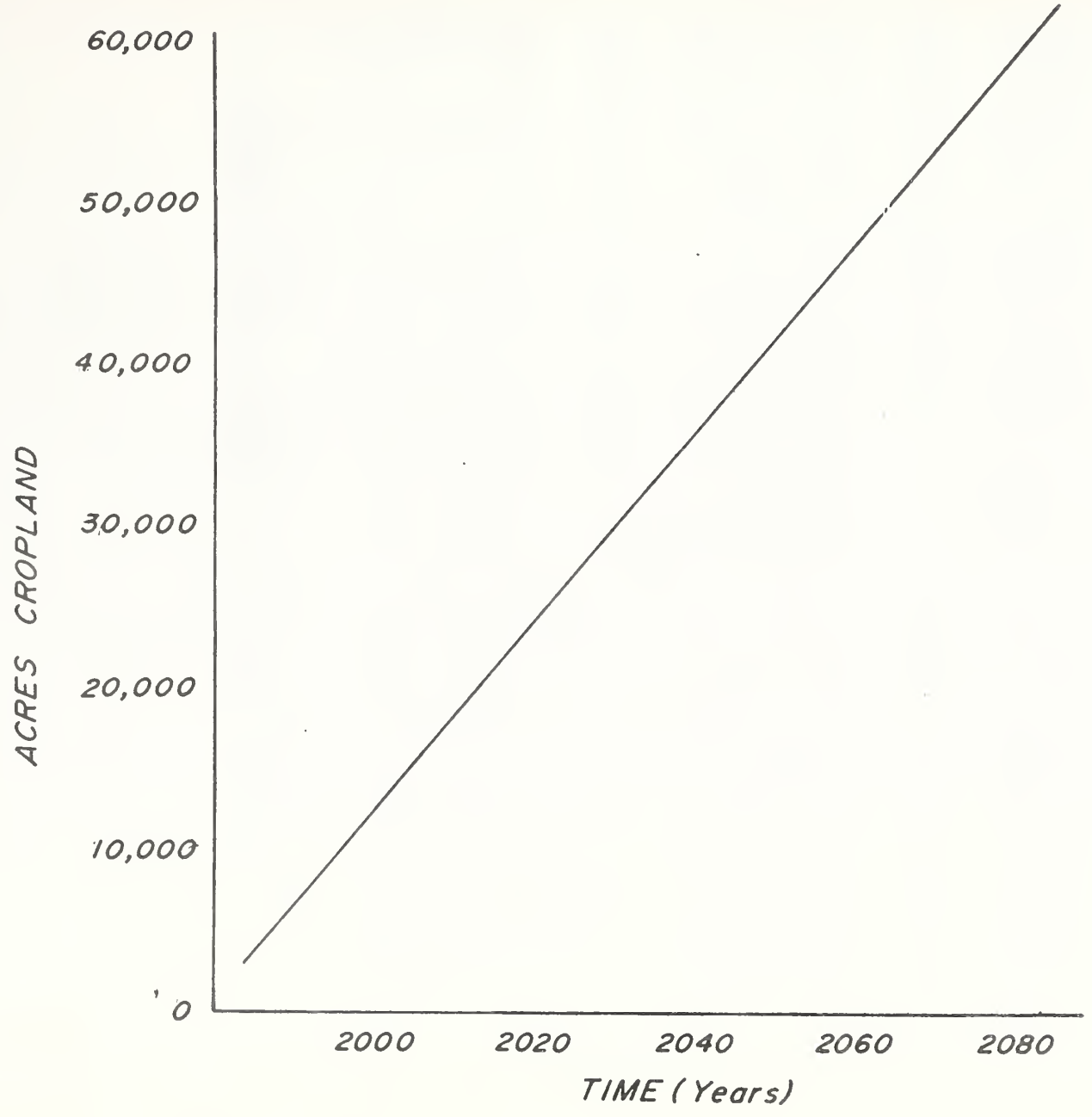


FIGURE III-C
Upper Neuse River Study Area, North Carolina
Cropland Erosion Phase III Change Projection (Without Treatment)



The total annual effect of sheet and rill erosion on cropland and pasture and hayland, in terms of phase changes is that the gross soil erosion occurring on tobacco, corn, soybeans, small grain, other crops, pasture, and hayland (587,189 tons/year) is equivalent to about 900 acres undergoing an erosion phase change, predominantly from phase II (93 percent of existing conditions) to phase III. A reasonable conclusion is that in about 100 years, enough soil loss will occur at present erosion rates to cause a phase change on every acre presently in cropland on phase I and II soils in the Basin. The real impact is that over 93 percent of these soils are presently in erosion phase II and if current trends are allowed to continue, these acres will deteriorate to the lowest defined production phase (phase III) in approximately 100 years. (Figures III-A, III-B, and III-C).

Erosion on non-agricultural land in the study area is significant, accounting for approximately 15 percent of the annual gross erosion. This erosion occurs on 60,076 acres of urban, residential, and other lands and amounts to 128,328 tons annually.

Losses in crop production resulting from excessive cropland erosion are presented in Figure III-D.

For each 225 tons of soil loss per acre exceeding soil loss tolerance ("T"), present crop yields are expected to be reduced over the time period during which the loss occurs as follows: Tobacco--11 percent; Corn--15.6 percent; Soybeans--22 percent; and Small Grain--10.5 percent. If, for example, erosion from cropland is 15 tons/acre/year over time (assuming "T" = 5 tons), accumulated soil erosion after 22.5 years would total 225 tons. Over this 22.5 year period. tobacco yields would decrease by 11 percent, corn by 15.6 percent, etc.

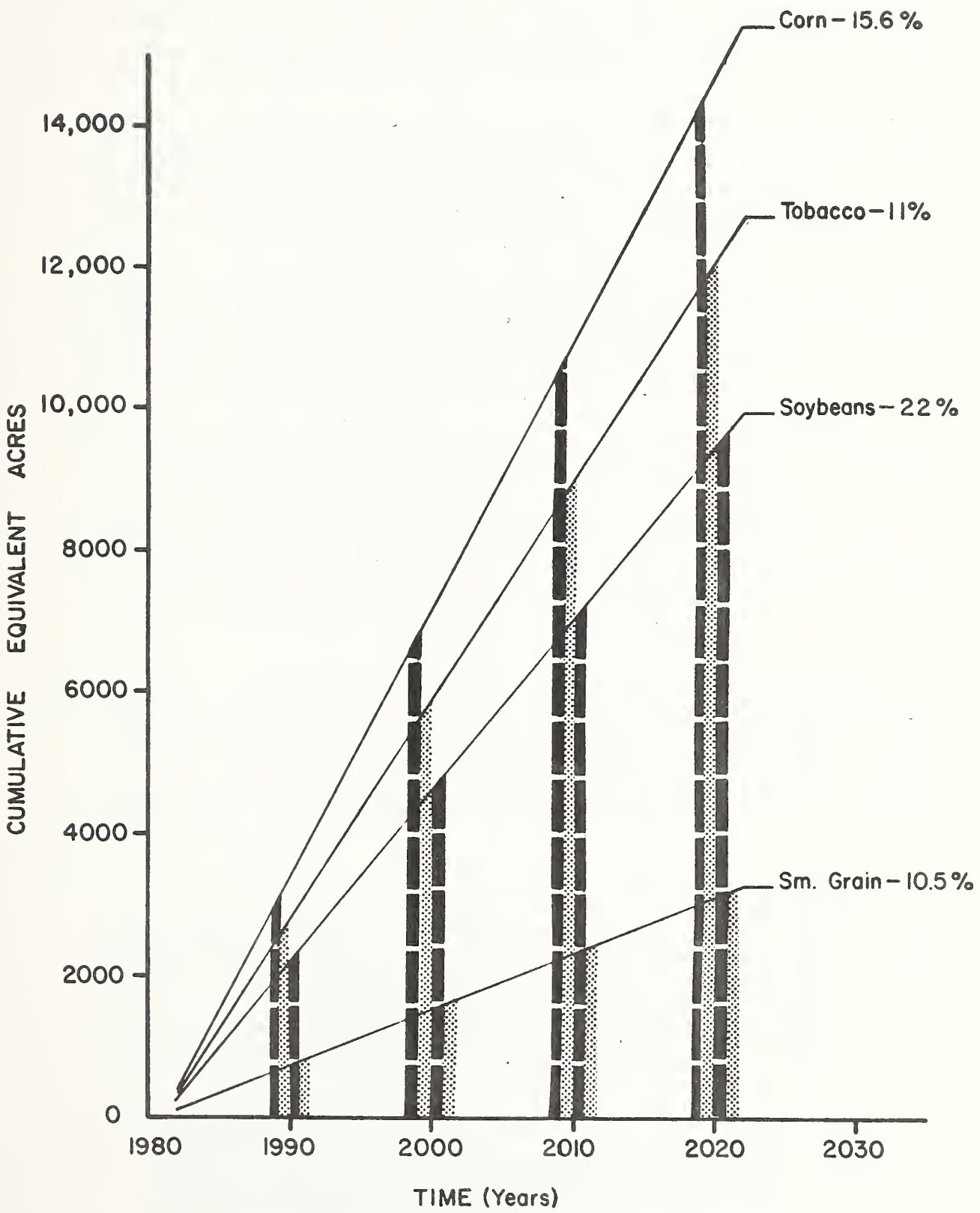
Potential tobacco yields (Figure III-D) are estimated to be reduced 11 percent for each 225 tons per acre or 1.5 inches of soil loss. 13/ 14/

Acres eroding less than five tons per acre per year are excluded from projections. Five tons per acre per year is considered within acceptable limits to maintain high productivity for an indefinite period of time. Present gross erosion on 17,311 acres is now 77,900 tons per year when "T" value is subtracted from the total. Therefore, 346 equivalent acres are now experiencing an 11 percent reduction in yield annually (77,900 ÷ 225 = 346).

13/ Adams, Williams E., 1949, Loss of Topsoil - Reduced Crop Yield. J. Soil and Waters. 4(3):130.

14/ Our Soils and Their Management, Roy L. Donahue, Interstate Publishers, Danville, Illinois, page 341. 1970.

FIGURE III-D
Upper Neuse River Study Area, North Carolina
Cropland Acreage Losing Production Potential Due To Erosion
(Projected From Existing Conditions)



Corn yields are reduced by almost 16 percent for each 225 tons per acre soil loss greater than tolerance levels. 14/ 15/ With the present gross erosion rate of 87,626 tons annually from corn land, about 390 equivalent acres are experiencing a 15.6 percent yield reduction. By the year 2000, cumulative acres with reduced yields will amount to about 7,020 and by 2020, to more than 14,820 acres.

Soybean production losses amount to about 22 percent per acre 16/ due to an average erosion rate of 9.9 tons per acre per year. Because of this excessive erosion, there are currently about 255 equivalent acres on which soybeans are producing less than potential. In 20 years, at this rate, the reduced yields will have occurred on more than 5,100 acres.

There is a 10.5 percent loss of small grain production potential due solely to erosion. 15/ Present gross erosion amounts to 18,531 tons annually (excluding 7,155 tons from 2,385 acres considered adequately treated and "T" value). The loss of production now occurs on about 82 equivalent acres and by the year 2020 will have occurred on more than 3,116 acres if present erosion rates are allowed to continue.

The relationship between levels of soil erosion and reductions in yields is summarized in Table III-2. The overall planning period is 1980-2020. As an example, the yield reduction for tobacco due to erosion in the 8-12 tons/acre/year soil loss group, with 10 tons/acre/year as the mid-point is derived as follows: 225 tons ÷ 5 tons/acre/year = 45 years; 40 year planning period ÷ 45 years = 0.90 x 11 percent yield reduction = 9.9 percent yield reduction for the planning period. With present levels of input use and management, soil productivity will be impaired on all lands eroding in excess of 5 tons/acre/year.

For tobacco, corn, and small grain, the cited articles (13/, 14/, 15/) represent a documentation of the relationship between erosion and reduced productivity. The 22 percent decrease in soybean production was established as a result of a consensus of SCS personnel from the State Resource Conservationist's Office, the Water Resources Planning Staff, and review and analysis of research from other sources, including Agricultural and Research Service "Erosion and Productivity Investigations, 1982".

There appears to be no significant adverse affects from forestry and silvicultural practices. Technical assistance provided by the state forester and volunteer application of best management practices by informed forestry operators will reduce present on-site disturbance and resultant erosion and sediment delivery. However, improvement is still needed to provide logging operators the best management techniques in road location and drainage which is the greatest single contributor to excessive forest land erosion and sediment delivery in the Basin.

15/ Soil Conservation, J. H. Stallings, Prentice-Hall, Inc., 1957, pages 207-217.

16/ Journal of Soil and Water Conservation, Volume 35, No. 3, page 133. "Predicting the Effects of Soil Depletion from Erosion." Rosenberry, Knutson, and Harmon.

TABLE III-2
Crop Yield Reductions Resulting from Soil Erosion for Untreated Conditions
(Without Technological Improvements), 1980-2020
Upper Neuse River Study Area, North Carolina

Erosion Group (Tons/Ac)	Tobacco		Corn		Soybeans		Small Grain	
	Acres	% Reduction	Acres	% Reduction	Acres	% Reduction	Acres	% Reduction
5-8	3,994	2.9	2,522	4.3	3,403	5.9	5,506	2.8
8-12	6,929	9.9	5,260	17.1	4,007	19.8	1,632	9.5
12-16	4,335	17.6	3,192	25.6	1,959	35.2	218	16.8
16-20	1,618	25.4	1,842	37.0	1,464	50.9	14	24.3
>20	436	48.9 1/	551	71.1 1/	241	97.8 1/	--	--

1/ Based on 30 t/ac./yr.

Off-Site Effects of Erosion

Excessive erosion from land preparation for agricultural production, from lands inadequately treated when urban development occurs, and from other land disturbances is the source of sediment that degrades water quality and fills ponds, stream channels, wetlands, and road ditches. Sediment accumulation in portions of the Upper Neuse amounts to greater than 10 feet in thickness. This occurs as a result of the estimated 257,150 tons of sediment delivered to the stream systems of the Basin annually. Should erosion and sediment yield continue at present rates, by the year 2020, nine million tons of sediment will have been deposited in the streams, of which about 7.8 million tons will have been transported by the Upper Neuse River system to Falls Reservoir.

Excessive erosion associated with agricultural activities contributes the greatest volume of sediment and suspended-solid loads to the streams. As the excessive erosion continues in the uplands, the downstream water quality continues to decline. Other potential agriculturally related pollution sources are pesticides and nutrients from cropland. Suspended solids, in the form of sediment and the turbidity it causes, are directly related to the erosion problem. Other pollutants, such as pesticides and herbicides, are frequently attached to soil particles, which in turn are transported with the soil to the stream.

With the ever-increasing sediment deposition, the esthetic values of the Upper Neuse River and tributaries will continue to be degraded.

A further decline in the quality of the fishery resource can be expected in the future. Sediment adversely affects fish populations by destroying habitat, spawning beds, eggs, and larval fish. Under severe conditions, such as found in portions of the Upper Neuse River, even adult fish are adversely affected. Sediment transported along stream bottoms as bedload also decreases fish populations by destroying bottom-dwelling organisms used by fish for food. The sand bedload produces little food for fish because of its instability and constantly shifting condition. In addition, aquatic habitats have been practically eliminated in some reaches of the channels by sediment while other reaches will continue to decline as increased sediment deposition occurs.

Land Use

Land use will be affected by several factors. The most important factor affecting future use of agricultural land is the economic returns to using land in agriculture relative to returns from other uses.

Population in the study area is projected to increase by about 23 percent during the 1980-2030 period. 17/ With a per person land requirement of .6 acres, an estimated 41,300 acres of land would need to be converted to nonagricultural uses. Much of this is expected to come from land currently in farms. Higher prices for land remaining in agriculture are likely to affect decisions for land use and investment

17/ See the "Social and Economic" section.

Erosion and sediment damages resulting from clearing of forestland for development.

These rough-graded streets suffer severe erosion while developer waits for approval of subdivision plans.

Sediment has turned this fish pond into a mud hole.

Golf course pond damaged by sediment from upstream construction site.

in agriculture. Uncertainty fueled by land speculation may cause some disinvestment and idling of land. If "normalized" price relationships for the 1977-81 period are assumed to hold for the future, 18/ land-use patterns over the planning period should reflect those of the late 1970's and early 1980's.

Government programs are important. The tobacco allotment program is assumed to continue. With ongoing soil erosion control programs, some land currently in production may be idled or shifted to permanent vegetation as reduced soil productivity lowers the profitability of using the land for crop production. Conversions to forest land would add to the capability for production of wood products as well as reduce levels of soil erosion on these lands. However, depending on the severity of the impaired eroded land, forest production would be at a reduced rate and require a longer rotation period. With accelerated erosion control programs, relatively more land currently in crop production should remain in that use. Changes in export markets, tax laws, and resource-use legislation are additional factors affecting future land use.

Projections for major uses of land in farms in the four county area were based on trends over the past 15-year period (Table III-3). 19/ Land in farms is projected to continue a downward trend primarily due to conversions of farmland to nonagricultural uses. Cropland acreage has remained relatively stable over the past 15 years. Cropland acreage is projected to decrease slightly by 2020, but acres of harvested cropland are expected to increase during the 1980-2020 period.

Historical trends for harvested acreage of major crops were also projected to year 2020 (Table III-4). Relatively more weight was given to acreage harvested during 1977-81, the period for which the most recent "normalized" prices apply. Acreage in corn is projected to decrease somewhat while soybean acreage to increase to about 24,000 acres.

Future land use will affect levels of crop production, value of agricultural production, and levels of soil erosion. The alternative land treatment systems analyzed in the next chapter will directly impact the levels of soil erosion and future productivity of the resource base as well as the landowner and public costs associated with implementing these treatment systems.

18/ "Normalized" prices are discussed in the "Social and Economic" section.

19/ These trends were shown in Table II-5 in the "Land-Use" section of the Concerns and Problems chapter.

TABLE III-3
Projections of Land in Farms, 1990-2020 [1/]
Upper Neuse River Study Area, North Carolina

Land Use	1978 [2/]	1990	2000	2020
	---------- Thousand Acres ----------			
Land in farms	460.4	450.0	440.0	420.0
All Cropland	191.1	188.0	185.0	180.0
Harvested Cropland	99.1	100.0	100.0	100.0
Cropland for Pasture	44.4	44.0	43.0	40.0
Other Cropland [3/]	47.6	44.0	42.0	40.0
Woodland, including Woodland Pasture	214.3	211.0	207.0	200.0
Other Land [4/]	55.0	51.0	48.0	40.0

1/ Durham, Granville, Orange, and Person Counties.
2/ 1978 Census of Agriculture.
3/ Land in soil improvement crops, land on which all crops failed, and idle cropland.
4/ Pastureland and rangeland other than cropland pasture and woodland pasture plus land in farmsteads, ponds roads, and wasteland.

TABLE III-4
Projections of Harvested Acres, Yields, and Production
for Major Crops, 1990-2020 1/
Upper Neuse River Study Area, North Carolina

Crop	1979-81 2/	1990	2000	2020
Corn (1,000 ac.)	26.9	27.0	26.0	24.0
Yield w/treatment (bu/ac.) 3/		80.0	85.0	95.0
Production (1,000 bu.) 4/		648.0	773.5	1,140.0
Yield w/out treatment (bu/ac.) 5/	61.1	65.0	68.0	75.0
Production (1,000 bu.)	1,644.3	1,228.5	1,139.7	900.0
Soybeans (1,000 ac.)	18.1	19.0	21.0	24.0
Yield w/treatment (bu/ac.) 3/		30.0	35.0	45.0
Production (1,000 bu.) 4/		171.0	259.0	486.0
Yield w/out treatment (bu/ac.) 5/	22.0	24.0	26.0	30.0
Production (1,000 bu.)	397.6	319.2	353.6	396.0
Tobacco (1,000 ac.)	22.9	24.5	25.5	27.0
Yield w/treatment (lb/ac.) 3/		2,000.0	2,200.0	2,500.0
Production (mil. lbs.) 4/		14.8	19.6	30.5
Yield w/out treatment (lb/ac.) 5/	1,800.0	1,850.0	1,900.0	2,000.0
Production (mil. lbs.)	41.2	31.6	31.5	29.6
Wheat (1,000 ac.) 6/	15.6	18.0	20.0	23.0
Yield w/treatment (bu/ac.) 3/		41.0	44.0	50.0
Production (1,000 bu.) 4/		221.4	308.0	517.5
Yield w/out treatment (bu/ac.) 5/	37.7	39.0	41.0	45.0
Production (1,000 bu.)	587.3	491.4	533.0	569.3
Hay (1,000 ac.)	16.5	18.0	19.5	23.0
Yield (tons/ac.) 7/	1.5	1.6	1.7	1.9
Production (1,000 tons)	24.7	28.8	33.2	43.7
Total (1,000 ac.)	100.0	106.5	112.0	121.0

1/ Durham, Granville, Orange, and Person Counties.
2/ North Carolina Crop and Livestock Reporting Service.
3/ With land treatments reducing soil erosion to "T" or less.
4/ Because significantly less acreage is adequately treated, production figures appear lower under this condition than those in the w/out treatment condition.
5/ Without any additional land treatments beyond those currently in place which are assumed to be maintained.
6/ Double cropped with soybeans.
7/ Soil erosion is not a problem.

Social and Economic

With a small study area, there are few bases for making projections. Trends in secondary data provide some indications. Contacts with landowners and(or) managers generate some information and insights into current conditions.

Population in the study area increased by nearly 19 percent during the 1970-80 period. Population is projected to increase by about 68,800 during 1980-2020--a 23 percent increase over the 1980 level. 20/ Some conversion of land to nonagricultural uses will occur. The increase in population will require additional educational, health, and utility services. Property taxes, including those on agricultural land, will likely increase. An increase in consumers should strengthen the local economy.

If the 1977-81 cost of production and "normalized" prices for farm products are representative of future cost-return relationships, returns to farming should not change substantially unless technological breakthroughs are developed. "Normalized" prices are weighted averages to adjust for short-term price fluctuations during this period. 21/

Several factors interacting to affect decisions concerning implementation of conservation practices have been identified. These include differences in public and private perceptions of soil erosion being a problem, who should pay for corrective measures, and who benefits from erosion control programs. Public impetus through accelerated informational programs and higher level of cost-sharing is expected to motivate landowners to install and maintain land treatment systems. The most important factor, however, is the profitability of farming which affects the landowner's financial capability for installing practices and the economic returns on practices. A case study showing the effects on net income through installation of all recommended conservation practices is presented in Appendix B. In this study, it was assumed that yields and cropping patterns would not vary before or following installation of land treatment systems.

20/ Preliminary projections of populations at the county and state levels have been developed by the North Carolina Department of Natural Resources and Community Development. The county level projections are disaggregated into study area shares based on the 1960-80 trend in the proportion of county population within the study area.

21/ Niehaus, Robert D., "Normalized Prices for Project Evaluation," Agricultural Economics Research, Vol. 28, No. 2, April 1976.

CHAPTER IV

ALTERNATIVES

Introduction

An evaluation of the problems and concerns has resulted in the recognition of erosion and associated sedimentation as the most critical problem. The prominence of prime and important lands is recognized, however, detailed soils information necessary for the identification and delineation of these lands is not available. Type 3 and 4 wetlands, basically associated with beaver ponds, are the only wetlands identified in the area. Therefore, only the problems associated with erosion and sedimentation will be addressed in the alternatives.

About 65 percent of the identified erosion problem occurs on cropland. Control of cropland erosion is the key to maintaining long-term productivity of the soil resource. Therefore, resource management systems for cropland erosion control have been analyzed and grouped according to the significance of erosion reduction when applied to a specific crop experiencing a particular erosion rate.

Three alternative plans for reducing erosion and sedimentation have been developed: (1) Continuation of the ongoing program; (2) Continuation of the ongoing program plus adequately treat all acres eroding greater than 12 tons per acre per year; and (3) Adequately treat all lands (see Tables IV-1, IV-2, and IV-3).

The recommended resource management systems (Tables IV-4 and IV-5) are effective and implementable in the study area. Each system is based on field office technical guides. Such factors as farm size, type of equipment, economics, crops grown, management capability, and others, affect the selection of systems for installation.

Costs of the systems were determined by examining costs of current construction in each district of the six-county area. A weighted average cost for each system has been used in deriving total costs for the alternatives.

Alternative No. 1 - Continuation of the ongoing program

Under this alternative, all resources would remain essentially in their present condition or continue to change as currently changing. Installation of conservation measures will continue at the present rate of application.

Technical assistance in forestry is on a first-come first-serve basis. It is expected that installation of forestry measures will be reduced in the immediate future owing to reduction in forestry personnel. This coupled with a decrease in cost-sharing in state and federal programs will increase the backlog of measures that are needed particularly in pine regeneration.

Currently, gross erosion amounts to almost 887,000 tons annually. Without an accelerated program, erosion would be reduced by only about 11 percent, or 96,526 tons annually, during the next ten years (Table IV-1). Sediment delivered to Falls Reservoir would decrease by about eight percent from 205,700 tons to 189,710 tons annually.

Presently, there are 58,228 acres in the study area eroding greater than five tons per acre per year. With a continuation of the on-going program to year 1990, erosion on approximately 41,728 of the acres would continue to exceed five tons per acre per year. The average erosion rate would be even higher than the present 9.52 tons per acre per year.

Table IV-1A presents the projected ongoing forestry program for Alternative No. 1.

Alternative No. 2 - Adequately treat all lands eroding greater than 12 tons per acre per year

The objective of this alternative is to reduce erosion (and resulting sedimentation) over a ten-year treatment period on all lands eroding in excess of 12 tons per acre per year (see Table IV-2). Erosion rates were calculated by applying the Universal Soil Loss Equation to current cropping patterns (1982). With this alternative, approximately 28,583 acres will be adequately treated including about 16,500 acres under the ongoing program. Land to be treated by various resource management systems is presented in Table IV-4. The most significant systems recommended for installation include crop rotations and conservation tillage in conjunction with terraces and/or diversions, grassed waterways and field borders. All other systems listed will be used, but to a lesser degree.

In addition to cropland, approximately 50 acres of critically eroding roadbanks and streambanks, and about 60 acres of other critically eroded areas would be stabilized. This stabilization will require slope shaping, seeding or sprigging, mulching and fertilization, and in some particularly severe locations rip-rap may be necessary.

Gross erosion would be reduced by about 24 percent, or from 886,897 tons annually to about 671,354 tons. Sediment yield would be reduced to about 161,125 tons annually from the present 205,700 tons. Of the 41,728 acres requiring treatment to reduce erosion to an acceptable level, approximately 29,645 would still lack adequate treatment.

Alternative No. 3 - Adequately treat all lands

Under this alternative, erosion on all lands would be reduced to within five tons per acre per year during a ten-year treatment period (see Table IV-3). Resource management systems recommended for installation in this alternative are shown in Table IV-5.

Gross erosion would be reduced by approximately 330,226 tons (37 percent) while a reduction in sediment yield would amount to about 35 percent, i.e., from 205,700 tons annually to about 133,625 tons.

TABLE IV-1 ALTERNATIVE NO. 1
Continuation of On-Going Program (10-Year Treatment Period)
Upper Neuse River Study Area, North Carolina

Existing Erosion Rate (t/ac/yr)	Land Use	Acres	Technical Assistance Available On-Going Program 1/ (Man-Yrs)	Land Treated On-Going Program (Acres)	Land Needing Treatment Accelerated Program (Acres)	Technical Assistance Needed Accelerated Program (Man-Yrs)	Present Soil Loss (t/yr)	Soil Loss Reduction to 5 t/ac/yr (t/yr)	Construction Cost 2/ (Dollars)	Technical Assistance Costs 3/ Planning (Dollars)	Application (Dollars)	Total Cost (Dollars)	Remaining Land Needing Treatment (Acres)
0-5	Small Grain	2,387	--	--	--	--	7,155	--	--	--	--	--	0
	Corn	2,565	--	--	--	--	7,695	--	--	--	--	--	0
	Tobacco	1,847	--	--	--	--	5,544	--	--	--	--	--	0
	Soybeans	1,681	--	--	--	--	5,013	--	--	--	--	--	0
	Other Crops	1,052	--	--	--	--	3,147	--	--	--	--	--	0
	Idle Cropland	7,029	--	--	--	--	21,087	--	--	--	--	--	0
	Pasture/Hayland	33,006	--	--	--	--	99,012	--	--	--	--	--	0
	Forestland	304,369	--	--	--	--	25,351	--	--	--	--	--	0
	Urban/Res.	50,870	--	--	--	--	67,137	--	--	--	--	--	0
	Other 4/	6,795	--	--	--	--	15,933	--	--	--	--	--	0
5-12	Small Grain	7,138	3.68	2,024	--	--	52,109	7,084	172,901	23,000	69,000	264,901	5,114
	Corn	7,782	4.01	2,206	--	--	68,993	7,721	181,640	25,063	75,188	281,891	5,576
	Tobacco	10,922	5.63	3,096	--	--	95,241	10,836	286,956	35,188	105,562	427,706	7,826
	Soybeans	7,410	2.82	2,101	--	--	62,180	7,354	190,802	23,875	71,625	286,302	5,309
	Other Crops	1,728	0.89	490	--	--	13,797	1,715	43,357	5,562	16,688	65,607	1,238
	Idle Cropland	1,860	0.96	528	--	--	13,014	1,848	79,200	6,000	18,000	103,200	1,332
	Pasture/Hayland	2,662	1.37	753	--	--	18,916	2,636	47,135	8,562	25,688	81,385	1,909
	Forestland	--	--	--	--	--	--	--	--	--	--	--	--
	Urban/Res.	97	0.05	28	--	--	715	98	4,200	312	938	5,450	69
	Other	1,772	0.91	500	--	--	9,632	1,750	75,000	5,687	17,063	97,750	1,272
>12	Small Grain	230	0.12	66	--	--	3,272	726	9,999	750	2,250	12,999	164
	Corn	5,585	2.88	1,584	--	--	90,242	17,424	258,468	18,000	54,000	330,468	4,001
	Tobacco	6,389	3.29	1,810	--	--	100,194	19,910	289,135	20,562	61,688	371,385	4,579
	Soybeans	3,664	1.88	1,034	--	--	59,456	14,344	168,829	11,750	35,250	215,829	2,630
	Other Crops	264	0.14	77	--	--	4,151	847	12,352	875	2,625	15,852	187
	Idle Cropland	64	0.03	16	--	--	916	176	5,600	750	2,250	8,600	48
	Pasture/Hayland	119	0.06	33	--	--	2,174	363	12,451	375	1,125	13,951	86
	Forestland	--	--	--	--	--	--	--	--	--	--	--	--
	Urban/Res.	20	0.01	6	--	--	280	66	2,100	62	188	2,350	14
	Other	522	0.27	148	--	--	34,631	1,628	40,156	1,687	5,063	46,906	374
	Total	469,829 5/ 6/	30.00	16,500	--	--	886,987	96,526	1,880,281	188,060	564,191	2,632,532	41,728

1/ The ongoing program allocates 3 man-years per year to the basin area.
2/ Average cost of applying needed conservation treatment based on 100 percent sample; Price 1982.
3/ Cost per man-year for technical assistance, including planning and application and benefits and administration, is $25,000. Twenty-five percent of the technical assistance cost is for planning and seventy-five percent is for application.
4/ Other includes rural residences, farmsteads, roadsides, streambanks, construction sites, etc.
5/ 58,228 acres eroding greater than 5 ton/acre/year.
6/ Does not include 23,367 acres in large lakes.

TABLE IV-1A
Alternative No. 1 - Summary
Continuation of On-Going Program 1/
(Projected 10-Year Treatment Program)
Technical Assistance and Land Treatment Practices - Forestry
Upper Neuse River Study Area, North Carolina

Private Non-Industrial Commercial Forest Land			
Management Practices	Units	Average Application Per Year	Projected Rate (10 Years)
Management Plans	Number	222	2,220
	Acres	18,443	184,430
Site Preparation			
K-G Blade	Acres	1,425	14,250
Drum/Chop/Burn	Acres	278	2,780
Burn Only	Acres	443	4,430
Total	Acres	2,146	21,460
Silvicultural Burn	Acres	85	850
Reforestation - Regeneration (FIP-ACP-NC)			
Planting	Acres	803	8,030
Seeding	Acres	35	350
Natural Regeneration	Acres	232	2,320
Total	Acres	1,071	10,710
Improve Growth			
TSI (Pine)	Acres	47	470
Wildlife Habitat			
Improvement	Acres	1,130	1,130
Cutting			
Fuelwood	Acres	224	2,240
Intermediate	Acres	721	7,210
Harvesting	Acres	622	6,200
Protection-Detection (Fire)			
Area Protected	M/Acres		
Burned	Acres	726	7,260

1/ The on-going program allocates 6.75 person-years annually to the study area counties: Durham, Granville, Orange, Person, and Wake.

TABLE IV-2 ALTERNATIVE NO. 2

Adequately Treat All Areas Eroding Greater than 12 Tons Per Acre Per Year (10-Year Treatment Period)
Upper Neuse River Study Area, North Carolina

Existing Erosion Rate (t/ac/yr)	Land Use	Acres	Technical Assistance Available On-Going Program 1/ (Man-Yrs)	Land Treated On-Going Program (Acres)	Land Needing Treatment Accelerated Program (Acres)	Technical Assistance Needed Accelerated Program (Man-Yrs)	Present Soil Loss (t/yr)	Soil Loss Reduction to 5 t/ac/yr (t/yr)	Construction Cost 2/ (Dollars)	Technical Assistance Costs 3/ Planning (Dollars)	Application (Dollars)	Total Cost (Dollars)	Remaining Land Needing Treatment (Acres)
0-5	Small Grain	2,387	--	--	--	--	7,155	--	--	--	--	--	0
	Corn	2,565	--	--	--	--	7,695	--	--	--	--	--	0
	Tobacco	1,847	--	--	--	--	5,544	--	--	--	--	--	0
	Soybeans	1,681	--	--	--	--	5,013	--	--	--	--	--	0
	Other Crops	1,052	--	--	--	--	3,147	--	--	--	--	--	0
	Idle Cropland	7,029	--	--	--	--	21,087	--	--	--	--	--	0
	Pasture/Hayland	33,006	--	--	--	--	99,012	--	--	--	--	--	0
	Forestland	304,369	--	--	--	--	25,351	--	--	--	--	--	0
	Urban/Res.	50,870	--	--	--	--	67,137	--	--	--	--	--	0
	Other 4/	6,795	--	--	--	--	15,933	--	--	--	--	--	0
5-12	Small Grain	7,138	3.68	2,024	--	--	52,109	7,084	172,901	23,000	69,000	264,901	5,114
	Corn	7,782	4.01	2,206	--	--	68,993	7,721	181,640	25,063	75,188	281,891	5,576
	Tobacco	10,922	5.63	3,096	--	--	95,241	10,836	286,956	35,188	105,562	427,706	7,826
	Soybeans	7,410	2.82	2,101	--	--	62,180	7,354	190,802	23,875	71,625	286,302	5,309
	Other Crops	1,728	0.89	490	--	--	13,797	1,715	43,357	5,562	16,688	65,607	1,238
	Idle Cropland	1,860	0.96	528	--	--	13,014	1,848	79,200	6,000	18,000	103,200	1,332
	Pasture/Hayland	2,662	1.37	753	--	--	18,916	2,636	47,135	8,562	25,688	81,385	1,909
	Forestland	--	--	--	--	--	--	--	--	--	--	--	--
	Urban/Res.	97	0.05	28	--	--	715	98	4,200	312	938	5,450	69
	Other	1,772	0.91	500	--	--	9,632	1,750	75,000	5,687	17,063	97,750	1,272
>12	Small Grain	230	0.12	66	164	0.30	3,272	2,530	34,825	2,625	7,875	45,325	0
	Corn	5,585	2.88	1,584	4,001	7.27	90,242	61,435	911,500	63,437	190,313	1,165,250	0
	Tobacco	6,389	3.29	1,810	4,579	8.32	100,194	70,279	1,020,600	72,562	217,688	1,310,850	0
	Soybeans	3,664	1.88	1,034	2,630	4.78	59,456	40,304	598,250	41,625	124,875	764,750	0
	Other Crops	264	0.14	77	187	0.34	4,151	2,904	42,350	3,000	9,000	54,350	0
	Idle Cropland	64	0.03	16	48	0.09	916	704	22,400	750	2,250	25,400	0
	Pasture/Hayland	119	0.06	33	86	0.15	2,174	1,309	28,600	1,312	3,938	33,850	0
	Forestland	--	--	--	--	--	--	--	--	--	--	--	--
	Urban/Res.	20	0.01	6	14	0.02	280	220	7,000	187	563	7,750	0
	Other	522	0.27	148	374	0.68	34,631	5,742	256,650	5,937	17,813	280,400	0
	Total	469,829 5/ 6/	30.00	16,500	12,083	21.95	886,987	215,633	4,003,366	324,684	974,067	5,302,117	29,645

1/ The on-going program allocates 3 man-years per year to the basin area.

2/ Average cost of applying needed conservation treatment based on 100 percent sample; Price 1982.

3/ Cost per man-year for technical assistance, including planning and application and benefits and administration, is $25,000. Twenty-five percent of the technical assistance cost is for planning and seventy-five percent is for application.

4/ Other includes rural residences, farmsteads, roadsides, streambanks, construction sites, etc.

5/ 58,228 acres eroding greater than 5 ton/acre/year.

6/ Does not include 23,367 acres in large lakes.

TABLE IV-3 ALTERNATIVE NO. 3
Adequately Treat All Lands (10-Year Treatment Period)
Upper Neuse River Study Area, North Carolina

Existing Erosion Rate (t/ac/yr)	Land Use	Acres	Technical Assistance Available On-Going Program 1/ (Man-Yrs)	Land Treated On-Going Program (Acres)	Land Needing Treatment Accelerated Program (Acres)	Technical Assistance Needed Accelerated Program (Man-Yrs)	Present Soil Loss (t/yr)	Soil Loss Reduction to 5 t/ac/yr (t/yr)	Construction Cost 2/ (Dollars)	Technical Assistance Costs 3/ Planning (Dollars)	Application (Dollars)	Total Cost (Dollars)	Remaining Land Needing Treatment (Acres)
0-5	Small Grain	2,387	--	--	--	--	7,155	--	--	--	--	--	0
	Corn	2,565	--	--	--	--	7,695	--	--	--	--	--	0
	Tobacco	1,847	--	--	--	--	5,544	--	--	--	--	--	0
	Soybeans	1,681	--	--	--	--	5,013	--	--	--	--	--	0
	Other Crops	1,052	--	--	--	--	3,147	--	--	--	--	--	0
	Idle Cropland	7,029	--	--	--	--	21,087	--	--	--	--	--	0
	Pasture/Hayland	33,006	--	--	--	--	99,012	--	--	--	--	--	0
	Forestland	304,369	--	--	--	--	25,351	--	--	--	--	--	0
	Urban/Res.	50,870	--	--	--	--	67,137	--	--	--	--	--	0
	Other 4/	6,795	--	--	--	--	15,933	--	--	--	--	--	0
5-12	Small Grain	7,138	3.68	2,024	5,114	9.29	52,109	24,983	638,505	81,062	243,188	962,755	0
	Corn	7,782	4.01	2,206	5,576	10.14	68,993	27,237	1,639,260	88,437	265,313	1,993,010	0
	Tobacco	10,922	5.63	3,096	7,826	14.23	95,241	38,227	2,032,920	124,125	372,375	2,529,420	0
	Soybeans	7,410	2.82	2,101	5,309	9.65	62,180	25,935	1,271,190	84,188	252,563	1,607,941	0
	Other Crops	1,728	0.89	490	1,238	2.25	13,797	6,048	195,250	22,125	66,375	283,750	0
	Idle Cropland	1,860	0.96	528	1,332	2.42	13,014	6,510	301,400	21,125	63,375	385,900	0
	Pasture/Hayland	2,662	1.37	753	1,909	3.47	18,916	9,317	212,035	30,250	90,750	333,035	0
	Forestland	--	--	--	--	--	--	--	--	--	--	--	0
	Urban/Res.	97	0.05	28	69	0.12	715	340	21,550	1,062	3,188	25,800	0
	Other	1,772	0.91	500	1,272	2.31	9,632	6,202	522,450	20,125	60,375	602,950	0
>12	Small Grain	230	0.12	66	164	0.30	3,272	2,530	34,825	2,625	7,875	45,325	0
	Corn	5,585	2.88	1,584	4,001	7.27	90,242	61,435	911,500	63,437	190,313	1,165,250	0
	Tobacco	6,389	3.29	1,810	4,579	8.32	100,194	70,279	1,020,600	72,562	217,688	1,310,850	0
	Soybeans	3,664	1.88	1,034	2,630	4.78	59,456	40,304	598,250	41,625	124,875	764,750	0
	Other Crops	264	0.14	77	187	0.34	4,151	2,904	42,350	3,000	9,000	54,350	0
	Idle Cropland	64	0.03	16	48	0.09	916	704	22,400	750	2,250	25,400	0
	Pasture/Hayland	119	0.06	33	86	0.15	2,174	1,309	28,600	1,312	3,938	33,850	0
	Forestland	--	--	--	--	--	--	--	--	--	--	--	0
	Urban/Res.	20	0.01	6	14	0.02	280	220	7,000	187	563	7,750	0
	Other	522	0.27	148	374	0.68	34,631	5,742	256,650	5,937	17,813	280,400	0
	Total	469,829 5/ 6/	30.00	16,500	41,728	75.83	886,987	330,226	9,756,735	663,934	1,991,817	12,412,486	0

1/ The on-going program allocates 3 man-years per year to the basin area.
2/ Average cost of applying needed conservation treatment based on 100 percent sample; Price 1982.
3/ Cost per man-year for technical assistance, including planning and application and benefits and administration, is $25,000. Twenty-five percent of the technical assistance cost is for planning and seventy-five percent is for application.
4/ Other includes rural residences, farmsteads, roadsides, streambanks, construction sites, etc.
5/ 58,228 acres eroding greater than 5 ton/acre/year.
6/ Does not include 23,367 acres in large lakes.

TABLE IV-4
Recommended Resource Management Systems To Be Applied
Alternative No. 2
Upper Neuse River Study Area, North Carolina

Resource Management System	Small Grain (Acres)	Tobacco (Acres)	Corn (Acres)	Soybeans (Acres)	Other Crops (Acres)	Installation Cost/Acre (Dollars)
Grassed Waterway (GW)	-- 1/	--	--	--	--	80
Field Border (FB)	--	--	--	--	--	35
Crop Residue Use (CRU)	--	--	--	--	--	5
Crop Rotation (Crop Residue) (CR)	--	--	--	--	--	10
Contour Farming (CF)	--	--	--	--	--	20
Stripcropping (50% to Grass) (SC)	--	521	489	137	--	60
Conservation Tillage (CT)	--	--	1564	555	74	15
Cropland to Grass (Conversion)	105	290	173	47	--	150
Terraces or Diversions (TR) (Including Contouring)	--	353	--	--	--	75
CF & GW	--	52	--	--	--	100
SC & TR	--	104	78	95	--	135
SC & FB	--	1545	1579	743	138	95
CT, FB, & GW	--	--	1054	1618	--	125
CT & FB	--	--	--	--	--	50
CT, TR, & FB	--	--	77	253	--	125
TR, GW, & FB	--	108	--	--	--	190
TR & FB	--	178	--	--	--	110
CRU & FB	--	--	--	--	--	40
GW & FB	--	--	--	--	--	115
CR, TR, & FB	--	80	--	--	--	125
CR & GW	--	--	--	--	--	90
CR & FB	--	--	--	--	--	45
CR, TR, GW, & FB	--	3033	437	137	--	200
CR & TR	50	--	--	--	--	85
Other Systems	75	125	134	79	52	--
Total	230	6389	5585	3664	264	--

1/ Dash represents less than 50 acres. Total included in Other Systems category.

TABLE IV-5
Recommended Resource Management Systems To Be Applied
Alternative No. 3
Upper Neuse River Study Area, North Carolina

Resource Management System	Small Grain (Acres)	Tobacco (Acres)	Corn (Acres)	Soybeans (Acres)	Other Crops (Acres)	Installation Cost/Acre (Dollars)
Grassed Waterway (GW)	-- 1/	--	--	--	--	80
Field Border (FB)	--	--	--	--	--	35
Crop Residue Use (CRU)	798	285	87	371	87	5
Crop Rotation (Crop Residue) (CR)	2685	2200	907	1218	226	10
Contour Farming (CF)	71	321	68	--	--	20
Stripcropping (50% to Grass) (SC)	414	1158	961	244	214	60
Conservation Tillage (CT)	369	--	3649	2657	204	15
Cropland to Grass (Conversion)	444	391	282	148	133	150
Terraces or Diversions (TR) (Including Contouring)	--	545	--	--	--	75
CF & GW	--	122	--	110	--	100
SC & TR	99	203	182	95	115	135
SC & FB	919	3701	4032	1453	304	95
CT, FB, & GW	768	--	2070	3933	502	125
CT & FB	--	--	72	--	50	50
CT, TR, & FB	--	--	139	266	61	125
TR, GW, & FB	71	144	--	--	--	190
TR & FB	66	1064	76	--	--	110
CRU & FB	--	--	--	--	--	40
GW & FB	--	281	56	--	--	115
CR, TR, & FB	--	317	--	--	--	125
CR & GW	144	471	--	--	--	90
CR & FB	--	246	--	109	--	45
CR, TR, GW, & FB	289	5620	480	227	58	200
CR & TR	115	--	--	--	--	85
Other Systems	118	242	306	243	38	--
Total	7368	17311	13367	11074	1992	--

1/ Dash represents less than 50 acres. Total included in Other Systems category.

Effects of Alternatives

Erosion

Only an 11 percent reduction in gross erosion would be realized under Alternative No. 1. Because of the streamlining effect of transport mechanisms (further deterioration of waterways, road ditches, etc.), sediment yield could possibly increase. Under Alternative No. 2, gross erosion would be reduced by about 215,633 tons (24 percent) and sediment yield by almost 44,600 tons. Installation of recommended conservation systems in Alternative No. 3 would result in an erosion and sediment yield reduction of about 330,226 tons (37 percent) and 72,075 tons (35 percent), respectively.

Soil productivity will be extended on all acres treated. Effects of alternatives on erosion rates and crop yields are shown in Table IV-6.

In conjunction with the water quality research and demonstration project in Northern Wake County (see page 21) one site is being monitored to evaluate the effectiveness of implementing a complete resource management system. System effectiveness is being evaluated in terms of reducing water runoff and associated sediments and nutrients. Preliminary estimates indicate a dramatic reduction in field runoff. As compared to the site without any treatment: water runoff was reduced by 50 percent; soil loss was reduced by 99 percent; and 80 percent less nitrogen and phosphorous fertilizer was lost.

Although reductions would not be as high on all cropland in the Upper Neuse as indicated by these preliminary results, it is anticipated that implementation of resource management systems under any of the three alternatives will result in reduced on- and off-site impacts. Final study results can be used to predict potential lessened water and land quality impacts with implementation of different alternatives.

Water Quality

As a portion of North Carolina's total water pollution planning effort required under Section 208 of the "Federal Water Pollution Control Act Amendments of 1972" (PL 92-500), a plan to limit agricultural nonpoint source water pollution was prepared by an Agricultural Task Force (ATF). The ATF, coordinated by the Soil and Water Conservation Commission, includes representatives of North Carolina State University, North Carolina Department of Agriculture, USDA-Soil Conservation Service, USDA-Agricultural Stabilization and Conservation Service, North Carolina Farm Bureau Federation, and the North Carolina State Grange.

The plan identifies water pollutants which can result from agricultural activities. Also, Best Management Practices (BMP's) were identified which are believed to effectively reduce sediments, pesticides, and nutrients from agricultural land. The BMP's recommended consist of a number of proven agricultural conservation techniques including soil and

A well established field border filters sediment, pesticides, and plant nutrients from runoff.

Roadbank erosion can be all but eliminated.

Two years no-till --- a conservation practice at work.

Small grain followed by two row soybeans followed by corn between soybean rows.

TABLE IV-6
Effects of Alternatives on Erosion Rates and Crop Yields, 1982-2020
Upper Neuse River Study Area, North Carolina

Crop	Acres Adequately Treated				Average Erosion Rate (t/ac./yr.)				Average Yields Per Acre [2/] [3/]			
	Pres.	Alt. 1 [1/]	Alt. 2 [1/]	Alt. 3 [1/]	Pres.	Alt. 1 [1/]	Alt. 2 [1/]	Alt. 3 [1/]	Pres.	Alt. 1 [4/]	Alt. 2 [4/]	Alt. 3 [4/]
Small Grain	2,387	4,477	4,641	9,755	6.41	5.61	5.42	5.0	38(bu)	38(bu)	39(bu)	39(bu)
Tobacco	1,847	6,753	11,332	19,158	10.49	8.88	6.26	5.0	1800(lbs)	1852(lb)	1938(lbs)	1978(lbs)
Corn	2,565	6,355	10,356	15,932	10.50	8.90	6.14	5.0	61(bu)	64(bu)	68(bu)	70(bu)
Soybeans	1,681	4,816	7,446	12,755	9.93	8.23	6.19	5.0	22(bu)	23(bu)	25(bu)	26(bu)

1/ At end of 10-year treatment period.

2/ Excluding future technological improvements.

3/ Based on a given percent increase for each 225 tons of soil saved (see page 38).

4/ By year 2020.

water conservation, optimal fertilizer usage, proper pesticide application, and improved animal waste management. Combinations of these BMP's make up resource management systems with the goals of efficient on-farm production and clean water. Implementation of the recommended resource management systems in any of the three alternatives to control erosion will similarly enhance water quality of the Neuse River stream system by reducing downstream sedimentation.

A reduction in high sediment levels will improve the streams' physical and biological character. Sunlight transmission and photosynthesis processes will be increased. Fish productivity will be restored or maintained as clogged channels are cleansed, and organisms vital to the food chain will increase. In addition, lower sediment levels will decrease water use treatment costs.

Sediment also transports some pesticides, nutrients, and other potential pollutants that are absorbed on the soil particles. Under certain conditions these absorbed materials may be released into the water with the potential to adversely affect water quality. A reduction in sediment delivery to the streams will reduce the nutrient loads. This will have a positive impact upon the downstream waters which are nutrient-sensitive at this time.

Additionally, the esthetic values of streams with clean water can be enhanced and appreciated by those who use the waters for leisure and recreational purposes.

Fishery Resource

The fishery resource in the Basin would be significantly improved by any land treatment program that would effectively reduce sediment delivered to the river and its tributaries. The beneficial effect would occur within the Upper Neuse area and also to the Lower Neuse River fishery resource.

A literature review indicates that little is known about the direct effect of sediment reduction on stream fisheries populations and/or eventual fish harvest. A general conclusion that can be drawn, however, is that both bedload and suspended sediment are harmful to the stream food chain and fish spawning activities. These two factors will largely determine the productivity of any given water body. Recovery rate for Piedmont streams is variable. Several surveys have indicated that if sediment delivery is curtailed, recovery will occur. However, the recovery rate based on degree of curtailment cannot be determined or declared cost-effective at this time. Experts in the biological arena are quick to point out that upstream areas or feeder streams are important sources of recolonization for benthic invertebrates and also are important for spawning of game fish. In addition, suspended sediment in a stream significantly affects the use of streams by the fishermen. This reduced utilization equals fewer fishermen days, and consequently, adverse economic effects.

Wildlife Resource

A land treatment program utilizing plans for erosion control that also have wildlife food and/or cover value should significantly improve the wildlife habitat values in the area. This effect will be most important to small game species such as quail or rabbits. Improved edge conditions through field border development and critical area stabilization will contribute to better small game habitat.

Comparison of Alternatives

All three alternatives are aimed at reducing erosion on 58,228 acres of land, including 31,912 acres of cropland, experiencing excessive erosion. A reduction in sediment yield and downstream sedimentation will result in improvements in water quality and fishery resources. Ten-year treatment periods are suggested in each alternative. Benefits of land treatment for each alternative are included in succeeding alternatives, i.e., resource management systems recommended in Alternatives 1 and 2 are included as part of the totals in Alternatives 2 and 3, respectively.

Alternative No. 1 would result in 16,500 acres being adequately treated. Thirty man-years would be required to install the recommended systems at a cost of about 2.63 million dollars. This amounts to an estimated cost of $159 per treated acre. Following the ten-year treatment period, 41,728 acres would remain inadequately treated. Though erosion would be reduced by eleven percent, sediment yield will increase by two percent.

Under Alternative No. 2, recommended resource management systems would be installed on 28,583 acres including 16,500 acres treated under the ongoing program. However, there would be 29,645 acres remaining inadequately treated. About 52 man-years would be necessary to plan and install the needed systems. Thirty of these man-years are accounted for in the ongoing program. Total cost of this alternative is about 5.3 million dollars, or an estimated $185 per treated acre. Erosion and sediment yield would be reduced by about 24 percent.

All lands would be adequately treated during the ten-year treatment period under Alternative no. 3. Total cost of the alternative would be 12.4 million dollars, or about $213 per treated acre. Erosion would be reduced by 37 percent and sediment yield reduction by 35 percent.

A summary comparison, including acres needing treatment, remaining needs, costs, and effects is presented in Table IV-7.

Soil Conservation --- strip cropping.

Soil conservation --- pasture management.

TABLE IV-7
Comparison of Alternatives
(10-Year Treatment Period)
Upper Neuse River Study Area, North Carolina

Comparison Item	Alternative No. 1	Alternative No. 2	Alternative No. 3
1. Land Needing Treatment (Acres)	58,228	58,228	58,228
2. Land Treated (Acres)	16,500	28,583	58,228
3. Remaining Land Needing Treatment (Acres)	41,728	29,645	-0-
4. Cropland acres on which a potential yield increase is anticipated due to a reduction in soil erosion 1/			
a. Tobacco	4,906	9,485	17,311
b. Corn	3,790	7,791	13,367
c. Soybeans	3,135	5,765	11,074
d. Small Grain	2,090	2,254	7,368
5. Technical Assistance Needed (Man-Years)	30	51.95	105.56
6. Cost-Technical Assist. (Dollars) 2/	752,251	1,298,751	2,655,751
7. Cost-Construction of Resource Management Systems (Dollars)	1,880,281	4,003,366	9,756,735
8. Total Cost	2,632,532	5,302,117	12,412,486
9. Erosion Reduction (Tons/Year)	96,526	215,543	330,226
10. Sediment Reduction (Tons/Year)	15,990	44,575	72,075

1/ From Tables IV-1, IV-2, and IV-3.
2/ Includes dollars for planning and application.

CHAPTER V

IMPLEMENTATION STRATEGIES

Introduction

Numerous strategies for protection of the land resources can be developed once the problems are defined and some degree of effect can be measured as a result of certain actions. A major benefit from this special erosion study would be for the reader to grasp the scope and nature of the problem and to formulate new and better strategies to solve these problems.

There are existing authorities and programs that are used traditionally to solve land and water resource problems. To fully develop and utilize the soil resources, application of land treatment is currently needed on 51,112 acres of cropland and 7,116 other acres. These 58,228 acres represent 12 percent of the study area. The remaining 88 percent is considered adequately treated.

A discussion of the existing strategies follows:

Land Treatment

Conservation land treatment is a basic element in formulating a watershed protection program. It is defined as applying management, cultural, and structural practices in such a manner that the land is used within the limits of its capabilities and soil erosion is held to acceptable levels. Land treatment is accomplished primarily through the development, implementation, and maintenance of conservation plans.

Conservation plans on individual units of land are documents that guide deliberate actions to accomplish land treatment. Conservation planning involves the use of inventory data for study, evaluation, and selection of the future courses of action. Each conservation plan is tailored to fit a particular unit of land by the landowner or operator with planning assistance from the Soil Conservation Service. SCS provides technical material and information on soils, water, animals, and plants which are needed by the landowner or operator in the decisionmaking process.

Technical assistance for land treatment is provided by SCS under authority of Public Law 46, 74th Congress. Assistance is given to landowners and operators through requests to local Soil and Water Conservation Districts. Financial assistance is available through the Agricultural Conservation Program (ACP) to install erosion control measures and other pollution control measures. The Agricultural Stabilization and Conservation Service administers the Agricultural Conservation Programs.

Authority for the ACP is provided in the Soil Conservation and Domestic Allotment Act of 1936. Objectives of the program are to control erosion and sedimentation, encourage voluntary compliance with Federal and State requirements to solve point and nonpoint source pollution, achieve

priorities in the National Environmental Policy Act, improve water quality, encourage energy conservation measures, and assure a continued supply of necessary food and fiber for a strong and healthy people and economy. The program will be directed toward the solution of critical soil, water, energy, woodland, and pollution abatement problems on farms and ranches.

Conservation practices are to be used on agricultural land and must be performed satisfactorily and in accordance with applicable specifications. Wildlife conservation practices must also conserve soil or water. Program participants are responsible for the upkeep and maintenance of practices installed with cost-share assistance. Cost-share assistance does not apply if the primary purpose is to bring new land into production.

Yields of chief crops in the Basin tend to be significantly lower than statewide averages. This implies that many farming operations are rather marginal. These farms have high erosion rates and are likely to be the ones least able to afford installation of currently used conservation practices, many of which have very high initial costs. Higher cost-sharing rates by USDA would be helpful, however, this would require new legislation and/or policy changes. The development and improvement of erosion control technology, such as the perfection and widespread adoption of conservation tillage, may provide less costly erosion control in the future.

Current cost-share payment up to 75 percent may be divided as a direct cost-share payment, or advance of conservation materials or services in lieu of payment.

Watershed Development

The Watershed Protection and Flood Prevention Act, Public Law 83-566, authorizes the Secretary of Agriculture to cooperate with State and local agencies in the planning and installation of works of improvement for soil conservation and for other purposes (see Appendix A). It provides for technical, financial, and credit assistance by the Department to local organizations representing the people living in small watersheds. It also provides for needed additional treatment and protection of federally owned lands within such watersheds. Moreover, the Act provides for a project-type approach to solving land, water, and related resource problems. It requires that full initiative and maximum responsibility for any undertaking be exercised by local people through their local organizations.

A major purpose of the Act is watershed protection which is defined as the protection of the watershed area through the establishment of land treatment measures to reduce erosion, sedimentation, and runoff where benefits accrue primarily onsite. Conservation land treatment measures would be installed at an accelerated rate through local soil and water conservation districts. Landowners or operators are responsible for the installation of conservation measures with technical assistance furnished by the Soil Conservation Service. Financial assistance can be obtained from the Agricultural Stabilization and Conservation Service, Farmers

Home Administration, and PL-566 project funds. The local people must be willing to carry out all phases of project installation, operation and maintenance, and must have the financial ability or be able to make adequate financial arrangements for carrying out their full responsibilities with relation to the project.

Resource Conservation and Development

Section 102 of the Food and Agriculture Act of 1962, Public Law 87-703, as amended, provides the Soil Conservation Service with authority to assist local people in planning and carrying out resource conservation and development projects. The locally initiated and sponsored projects are designed to promote orderly conservation, improvement, development, and wise use of natural resources. Objectives also include initiating a long-range program of resource conservation and development for purposes of achieving a dynamic rural community with satisfactory level of income and pleasing environment, and creating a favorable investment climate attractive to private capital.

Technical and financial assistance is available only for RC&D areas authorized for assistance. Technical and financial assistance is available for the planning and installation of approved measures specified in RC&D area plan serving purposes such as flood prevention, sedimentation and erosion control, public water based recreation and fish and wildlife developments, agricultural water management purposes, water quality management, control and abatement of agriculture-related pollution.

Rural Clean Water Program (RCWP)

The objectives of RCWP are to develop and test methods for improving water quality by assisting agricultural landowners in reducing agricultural nonpoint source pollutants. Authority is provided under Public Law 96-108, the Agriculture, Rural Development, and Related Agencies Appropriation Act of 1980.

The RCWP provides financial and technical assistance to private landowners and operators in approved project areas. The assistance is provided through long-term contracts of 3 to 10 years to install best management practices to solve critical water quality problems resulting from agricultural nonpoint source pollution. The project area must reflect the water quality priority concerns developed through the established water quality management process. Participation is voluntary.

RCWP is only applicable to privately owned agricultural lands in approved project areas. Any landowner or operator in an approved project area whose land or activity contributes to the area's water quality problems and who has an approved water quality plan may enter into an RCWP contract. An individual partnership, corporation (except corporations whose stock is publicly traded), Indian tribe, irrigation district, or other entities are eligible. Federal, State, or local governments, or subdivisions thereof, except irrigation districts, are not eligible.

Target Area Erosion Control

The Chief of the Soil Conservation Service has the authority to distribute funds to certain approved targeted areas for erosion control. A proposal has been developed and approved for such an area, the Piedmont Bright Leaf Erosion Control Area of North Carolina and Virginia. Portions of the Upper Neuse study area lie within the 13 county area of North Carolina.

The objectives to be accomplished in the targeted area are:

1. Protection of the soil resource base and improvement of productive capability through a significant reduction in annual soil losses.

2. Improved water quality through sediment reduction and decreased runoff of pesticides and nutrients.

3. Increased soil organic matter levels to better utilize water and nutrients and improve effectiveness of agriculture chemicals.

4. Increased irrigation water efficiency.

5. Increased use of conservation tillage systems to prevent erosion, conserve moisture and save energy.

6. Increased use of fescue in tobacco rotations and use of conservation systems rather than individual practices.

7. Improved profit margins for the area's farmers.

A 10-year program is planned for the targeted counties to reduce erosion, improve irrigation water management, increase soil productivity, reduce water pollution and finally improve the income of the farmers. Through additional technical and financial assistance the program will help local landusers install needed conservation systems to accomplish the above goals.

A cost-share program is needed to accelerate the installation of conservation systems. Because of the number of small farms, it is recommended that cost-sharing be 75 percent federal and 25 percent supplied by local farmers. Cost-sharing would be based on the average cost of installing conservation systems and would be carried out through long-term agreements between the farmer and USDA. Special ACP funds should be made available so that special emphasis can be placed on using ACP long-term agreements and other cost-sharing.

Information and education work can be done by members of the Rural Development Panels, or by the agricultural agencies in counties that do not have Rural Development Panels. Adequate funding should be made available to the Agricultural Extension Service to provide an educational specialist in each state to work in the project area. These specialists would plan and conduct extensive media programs, coordinate

demonstrations and test plots, conduct group meetings and seminars, coordinate information activities with other agencies, develop cost-benefit information for conservation systems and promote additional conservation research.

Forestry Incentives Program (FIP)

The objectives of FIP are to bring private nonindustrial forest land under intensified management; to increase timber production; to assure adequate supplies of timber; and to enhance other forest resources through a combination of public and private investments on the most productive sites on eligible individual or consolidated ownerships of efficient size and operation.

Cost-sharing is available under the Forestry Incentives Program for tree planting and timber stand improvement. Special forestry practices may be approved if needs for a significant and unique local condition for which national FIP practices are not adequate. Owners of non-industrial private forest lands of 1,000 acres or less, capable of producing industrial wood crops are eligible for Forestry Incentives Program cost-sharing. In order for an individual within a county to receive Forestry Incentives Program funds, the county must be designated as a Forestry Incentives Program county by the State committee in consultation with the State Forester. In counties designated for Forestry Incentives Program, the individual landowner is required to have a forest management plan, developed by the State Forester and landowner.

North Carolina Forest Development Program

The Forest Development Program is designed to aid private landowners reforest after harvest and to place their idle and unproductive forest land into full timber production. Assistance is available from the North Carolina Division of Forest Resources, County Agricultural Extension Agents, and the ASCS.

Cooperative Forestry Assistance

The Cooperative Forestry Assistance Act provides funding and assistance to the State Foresters in programs on non-federal forest lands in the advancement of forest resources management; the production of timber; the prevention and control of insects, diseases and rural fires; the efficient utilization of wood and wood fiber; fish and wildlife habitat maintenance and improvement; and the planning and conduct of urban forestry programs.

Economic Recovery Tax Act, PL 96-451 (1981)

This act allows landowners to recover reforestation costs in the first seven years after stand is established. Up to $10,000 in qualifying reforestation costs can qualify each year. Rather than capitalizing reforestation costs, as in the past, landowners can now write-off one-fourteenth of the cost against taxable income in the first year. One-seventh of the costs are charged in each of the succeeding six

years, and one-fourteenth in the eighth taxable year after reforestation. Reforestation costs can also qualify for an investment tax credit of up to ten percent under the new law. With this law, costs of reforestation, such as site preparation and planting, offset taxable income at the beginning of the rotation instead of being recovered by depletion when timber is harvested. Costs above the $10,000 limit are capitalized and recovered through depletion as before. This limit leads to substantially greater benefits for both small and large forest landowners.

Forestry tax incentive legislation passed into law by the 1979 General Assembly is included in Senate Bill 904 and consists primarily of amendments to the existing Revenue Act.

G.S. 105-141 (b) is amended to exclude from gross income payments received under FIP, the State Forest Development Program, ACP, and other cost-sharing programs so excluded from the federal taxable income.

G.S. 105-144.5 is an addition to allow any individual who meets the landowner qualification requirements for receipt of FIP payments to elect to report gross income from timber sales over a three-year period. Proration is made at the rate of one-third per year beginning with the year in which the income is realized and continuing through the two succeeding two years.

G.S. 105-147 is amended to add a section which allows amortization of reforestation expenses over a period of 60 months. Such expenses include costs of site preparation, natural and artificial forestation, non-commercial removal of residual stands for silvicultural purposes, and cultivation of established young growth of desirable trees. Amounts so amortized shall not include incentive payments received under FIP or the Forest Development Program.

G.S. 105-130.5 (b) lists deductions from federal taxable income to be made in determining state net income. It is amended to allow deductions from income of reasonable expenses for reforestation and cultivation of commercially grown trees that are in excess of deductions allowed for federal income tax purposes. Such deductions are allowed to individuals and to corporations in which the "real owners of all shares of such corporation are natural persons engaged in the commercial growing of trees or the spouse, siblings, or parents of such persons."

G.S. 113-120.5 Amendments were made to existing legislation to absolve forest landowners of liability resulting from injury to persons gathering fuel wood or other forest products from woodlots with permission of the landowner but with no payment for the material removed.

APPENDIX A

MAPS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

VICINITY MAP

BASE LEGEND

- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- SECONDARY STATE HIGHWAY
- INTERSTATE ROAD
- PRIMARY ROAD
- SECONDARY ROAD
- TOWN AND URBAN AREA
- DRAINAGE
- COUNTY BOUNDARY
- STUDY AREA BOUNDARY

UPPER NEUSE RIVER BASIN STUDY AREA

Portions of

DURHAM, FRANKLIN, GRANVILLE, ORANGE, PERSON AND WAKE COUNTIES
NORTH CAROLINA

Approximate Scale Miles

Approximate Scale Km

Material prepared by Field Personnel.
Maps generated by North Carolina Department of Natural Resources.
and Community Development, Land Resources Information Service.

MARCH 1983 BASE 4-R 38185

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

VICINITY MAP

BASE LEGEND

- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- SECONDARY STATE HIGHWAY
- INTERSTATE ROAD
- PRIMARY ROAD
- SECONDARY ROAD
- TOWN AND URBAN AREA
- DRAINAGE
- COUNTY BOUNDARY
- STUDY AREA BOUNDARY

LEGEND

- CROPS
- PASTURE AND HAYLAND
- FOREST AND WATER
- OTHER

LAND USE MAP

UPPER NEUSE RIVER BASIN STUDY AREA

Portions of

DURHAM, FRANKLIN, GRANVILLE, ORANGE, PERSON AND WAKE COUNTIES
NORTH CAROLINA

Approximate Scale Miles

Approximate Scale Km

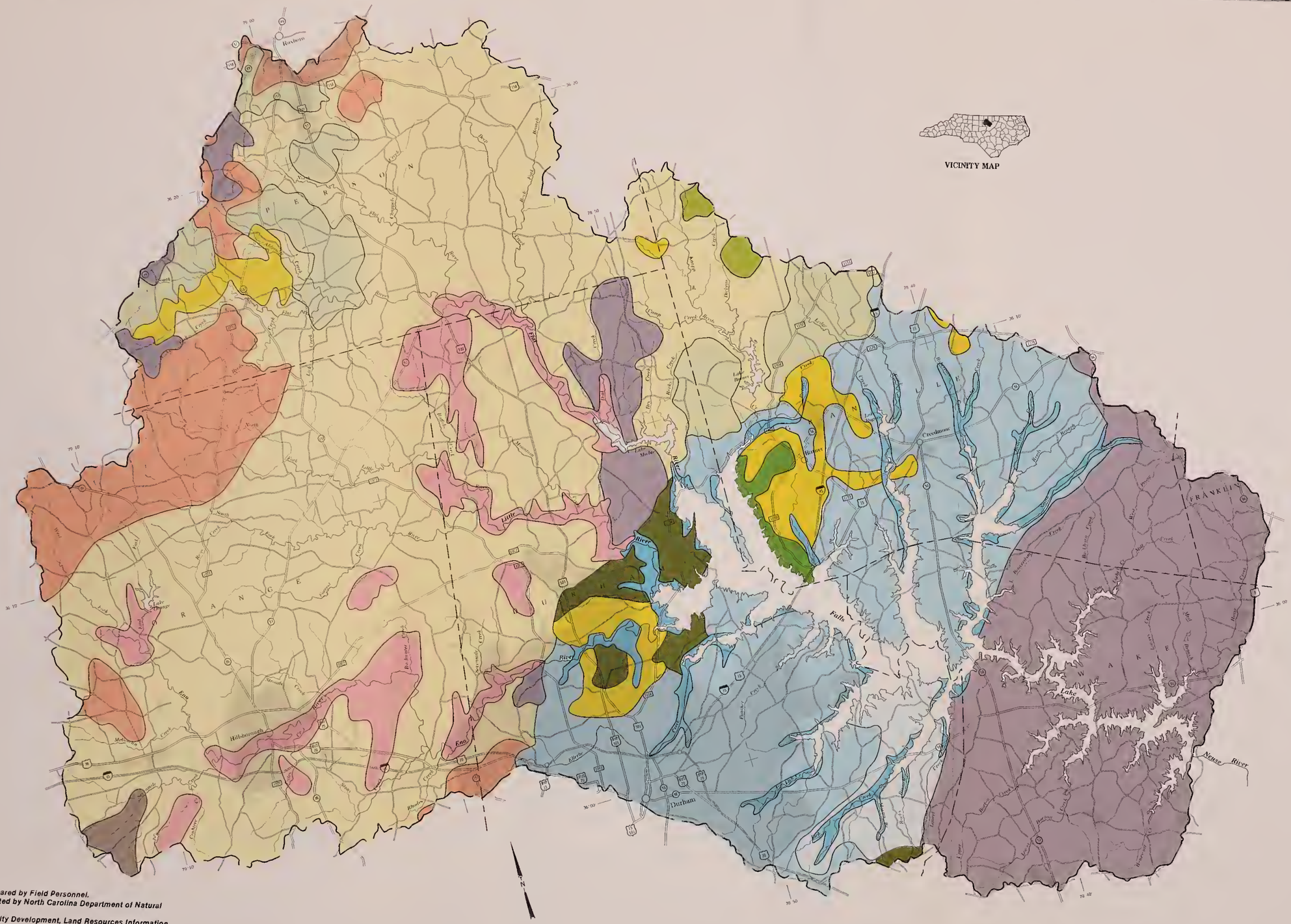
Material prepared by Field Personnel.
Maps generated by North Carolina Department of Natural Resources.
and Community Development, Land Resources Information Service.

USDA SCS FORT WORTH, TEXAS 1982

JULY 1983 4-R-38310

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



VICINITY MAP

BASE LEGEND

- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- SECONDARY STATE HIGHWAY
- INTERSTATE ROAD
- PRIMARY ROAD
- SECONDARY ROAD
- TOWN AND URBAN AREA
- DRAINAGE
- COUNTY BOUNDARY
- STUDY AREA BOUNDARY

LEGEND

- CECIL - MADISON - APPLING
- WHITE STORE - PINKSTON
- WHITE STORE - CREEDMOOR
- WEHADKEE - CHEWACLA - ROANOKE
- IREDELL - MECKLENBURG - ENON
- GEORGEVILLE - TATUM - HERNDON
- ENON - HELENA - VANCE
- BADIN - GOLDSTON - WILKES
- ORANGE - VAUCLUSE - LILLINGTON
- MAYODAN - GRANVILLE - CREEDMOOR
- TATUM - GOLDSTON - BADIN
- HELENA - APPLING - VANCE
- WEDOWEE - LOUISBURG
- LIGNUM - ENON - ORANGE

GENERAL SOILS MAP

UPPER NEUSE RIVER BASIN STUDY AREA

Portions of

DURHAM, FRANKLIN, GRANVILLE, ORANGE, PERSON AND WAKE COUNTIES
NORTH CAROLINA

Approximate Scale - Miles

Approximate Scale - Km

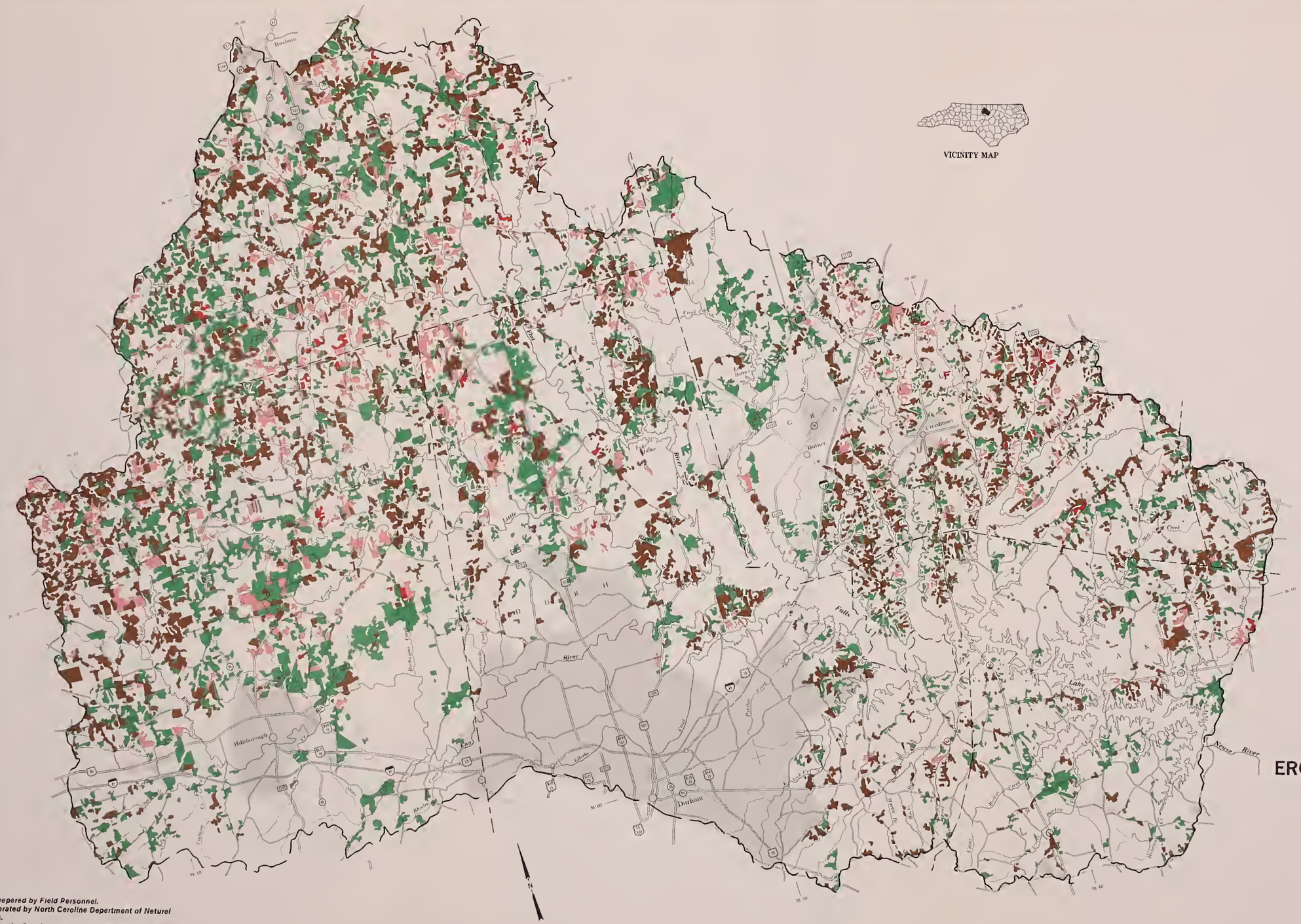
Material prepared by Field Personnel.
Maps generated by North Carolina Department of Natural Resources.
and Community Development, Land Resources Information Service.

USDA-SCS-FORT WORTH, TEXAS 1983

JULY 1983 4-R-38298

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



VICINITY MAP

BASE LEGEND

- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- SECONDARY STATE HIGHWAY
- INTERSTATE ROAD
- PRIMARY ROAD
- SECONDARY ROAD
- TOWN AND URBAN AREA
- DRAINAGE
- COUNTY BOUNDARY
- STUDY AREA BOUNDARY

LEGEND

- 0-5 TONS/ACRE/YEAR
- 5-12 TONS/ACRE/YEAR
- 12-20 TONS/ACRE/YEAR
- > 20 TONS/ACRE/YEAR

EROSION MAP - TONS/ACRE/YEAR

UPPER NEUSE RIVER BASIN STUDY AREA

Portions of

DURHAM, FRANKLIN, GRANVILLE, ORANGE, PERSON AND WAKE COUNTIES
NORTH CAROLINA

Approximate Scale - Miles

Approximate Scale - Km

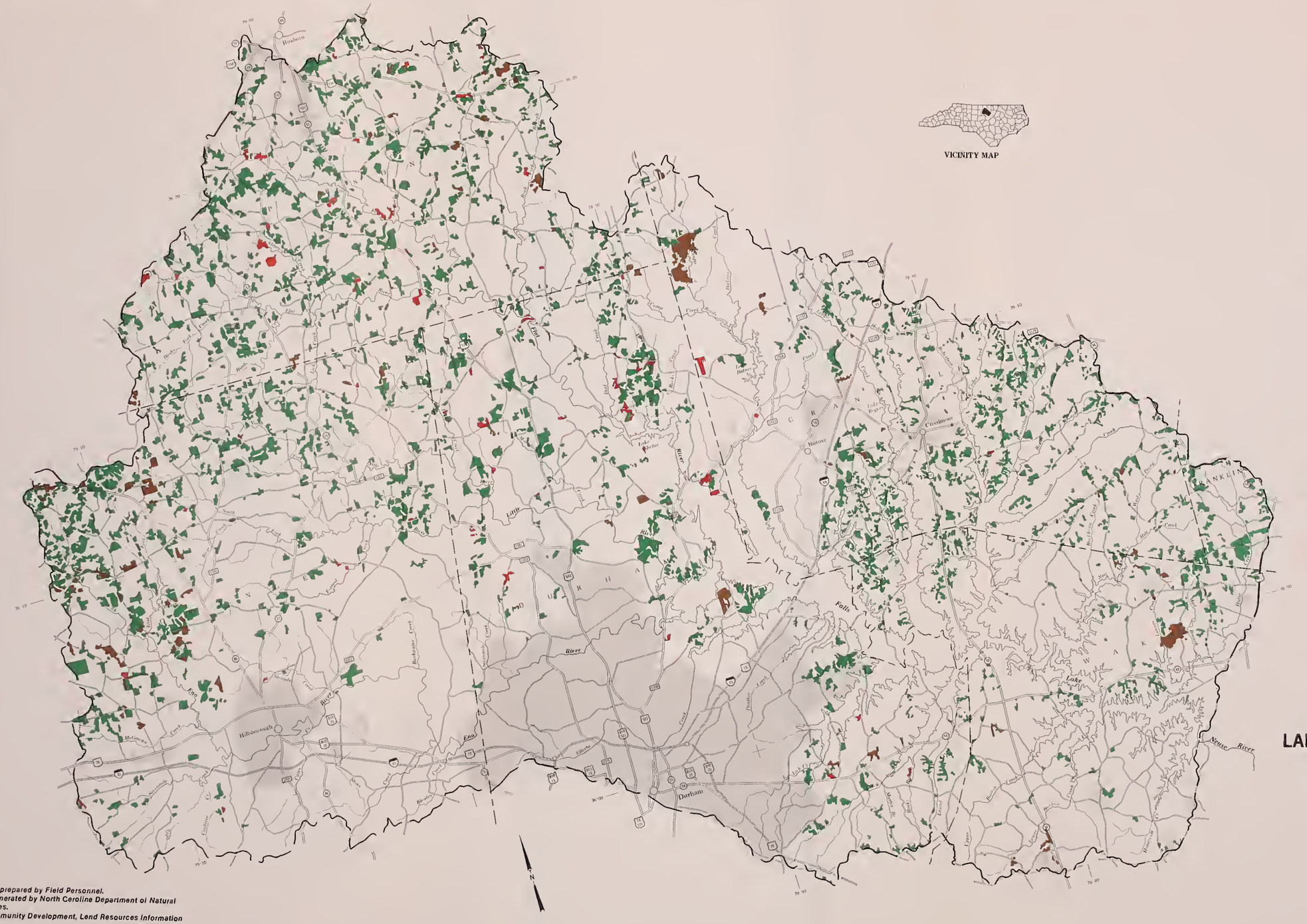
Material prepered by Field Personnel.
Maps generated by North Ceroline Department of Neturel Resources.
and Community Development, Land Resources Information Service.

JULY 1983 4-R-38313

USDA-SCS-FORT WORTH, TEXAS 1983

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



VICINITY MAP

BASE LEGEND

- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- SECONDARY STATE HIGHWAY
- INTERSTATE ROAD
- PRIMARY ROAD
- SECONDARY ROAD
- TOWN AND URBAN AREA
- DRAINAGE
- COUNTY BOUNDARY
- STUDY AREA BOUNDARY

LEGEND

(AREAS ERODING BETWEEN 5 AND 12 TONS/ACRE/YEAR)

- CROPS
- PASTURE AND HAYLAND
- FOREST AND WATER
- OTHER

LAND USE AND EROSION MAP

(EROSION 5 TO 12 T/AC/YR)

UPPER NEUSE RIVER BASIN STUDY AREA

Portions of

DURHAM, FRANKLIN, GRANVILLE, ORANGE, PERSON AND WAKE COUNTIES
NORTH CAROLINA

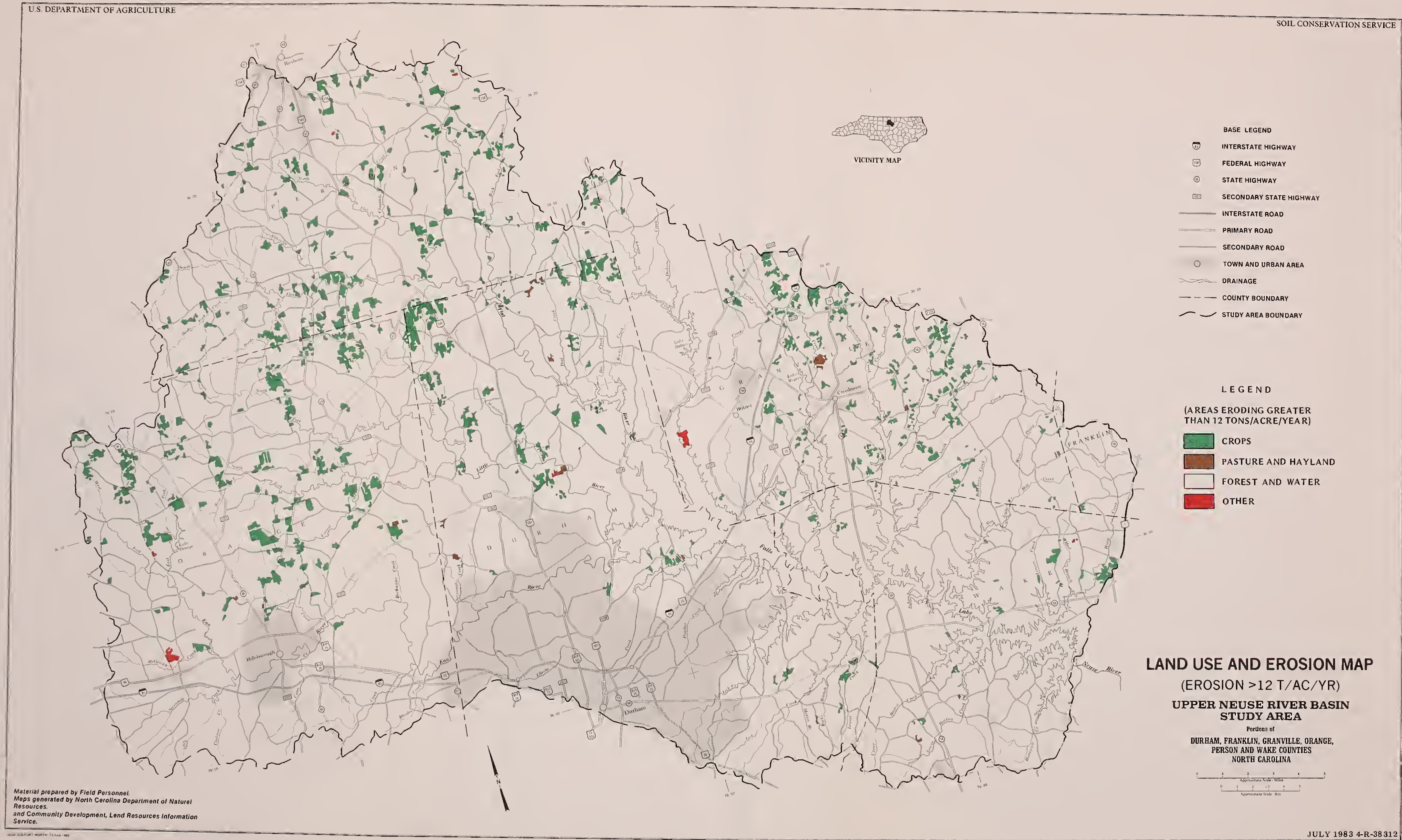
Approximate Scale Miles

Approximate Scale Km

Material prepared by Field Personnel.
Maps generated by North Carolina Department of Natural Resources,
and Community Development, Land Resources Information Service.

USDA-SCS-FORT WORTH, TEXAS 1983

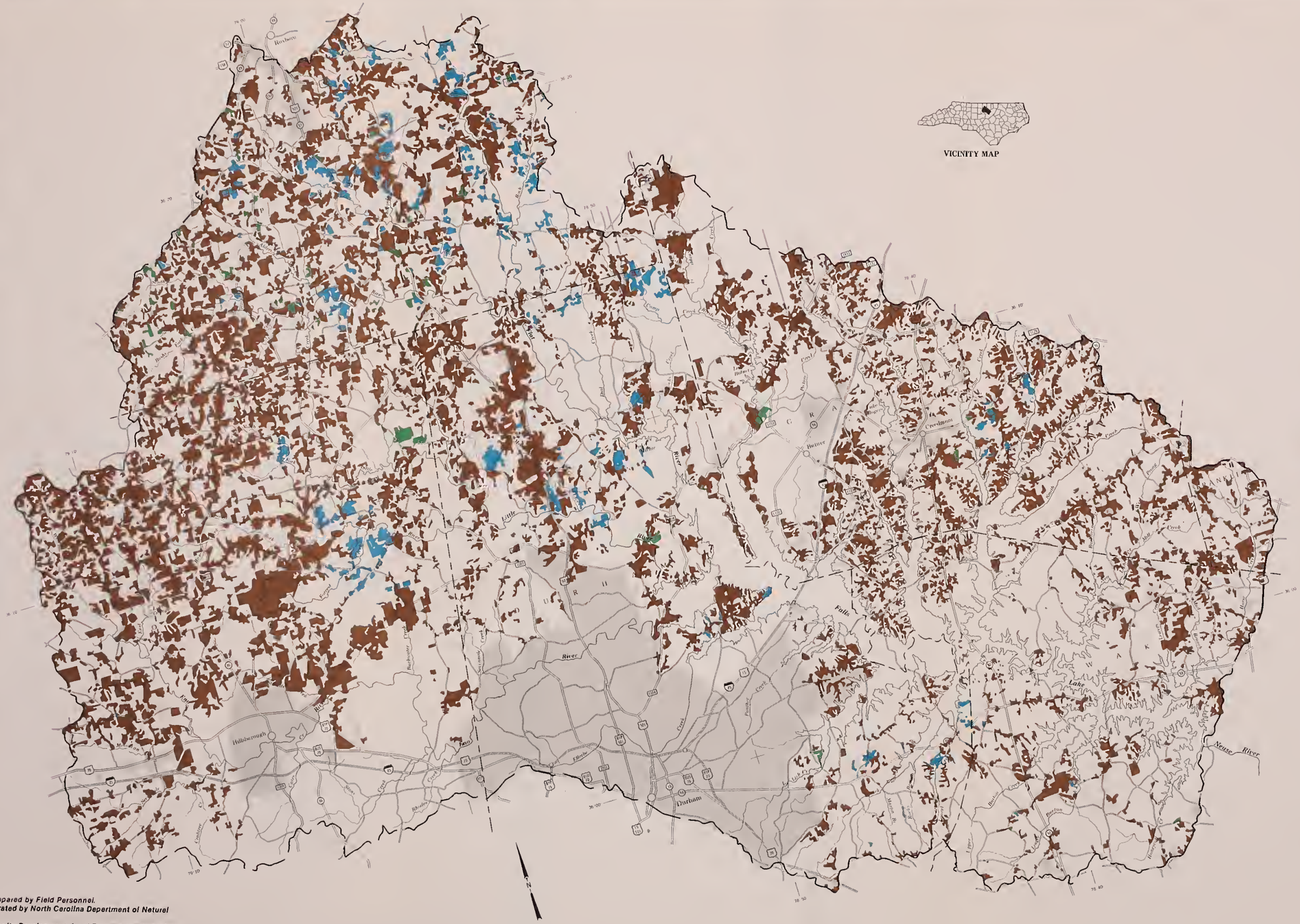
JULY 1983 4-R-38311



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
VICINITY MAP
BASE LEGEND
INTERSTATE HIGHWAY
FEDERAL HIGHWAY
STATE HIGHWAY
SECONDARY STATE HIGHWAY
INTERSTATE ROAD
PRIMARY ROAD
SECONDARY ROAD
TOWN AND URBAN AREA
DRAINAGE
COUNTY BOUNDARY
STUDY AREA BOUNDARY
LEGEND
(AREAS ERODING GREATER THAN 12 TONS/ACRE/YEAR)
CROPS
PASTURE AND HAYLAND
FOREST AND WATER
OTHER
LAND USE AND EROSION MAP
(EROSION >12 T/AC/YR)
UPPER NEUSE RIVER BASIN
STUDY AREA
Portions of
DURHAM, FRANKLIN, GRANVILLE, ORANGE,
PERSON AND WAKE COUNTIES
NORTH CAROLINA
Approximate Scale - Miles
Approximate Scale - Km
JULY 1983 4-R-38312
Hillsborough
Durham
Creedmoor
Butner
FRANKLIN
Neuse River
Material prepared by Field Personnel.
Meps generated by North Cerolina Department of Naturel Resources.
and Community Development, Lend Resources Information Service.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



VICINITY MAP

BASE LEGEND

- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- SECONDARY STATE HIGHWAY
- INTERSTATE ROAD
- PRIMARY ROAD
- SECONDARY ROAD
- TOWN AND URBAN AREA
- DRAINAGE
- COUNTY BOUNDARY
- STUDY AREA BOUNDARY

LEGEND

- PHASE I - GREATER THAN 6 INCHES TOPSOIL
- PHASE II - BETWEEN 3 INCHES AND 6 INCHES TOPSOIL
- PHASE III - LESS THAN 3 INCHES TOPSOIL

EROSION PHASE MAP

UPPER NEUSE RIVER BASIN STUDY AREA

Portions of

DURHAM, FRANKLIN, GRANVILLE, ORANGE, PERSON AND WAKE COUNTIES
NORTH CAROLINA

Approximate Scale Miles

Approximate Scale Km

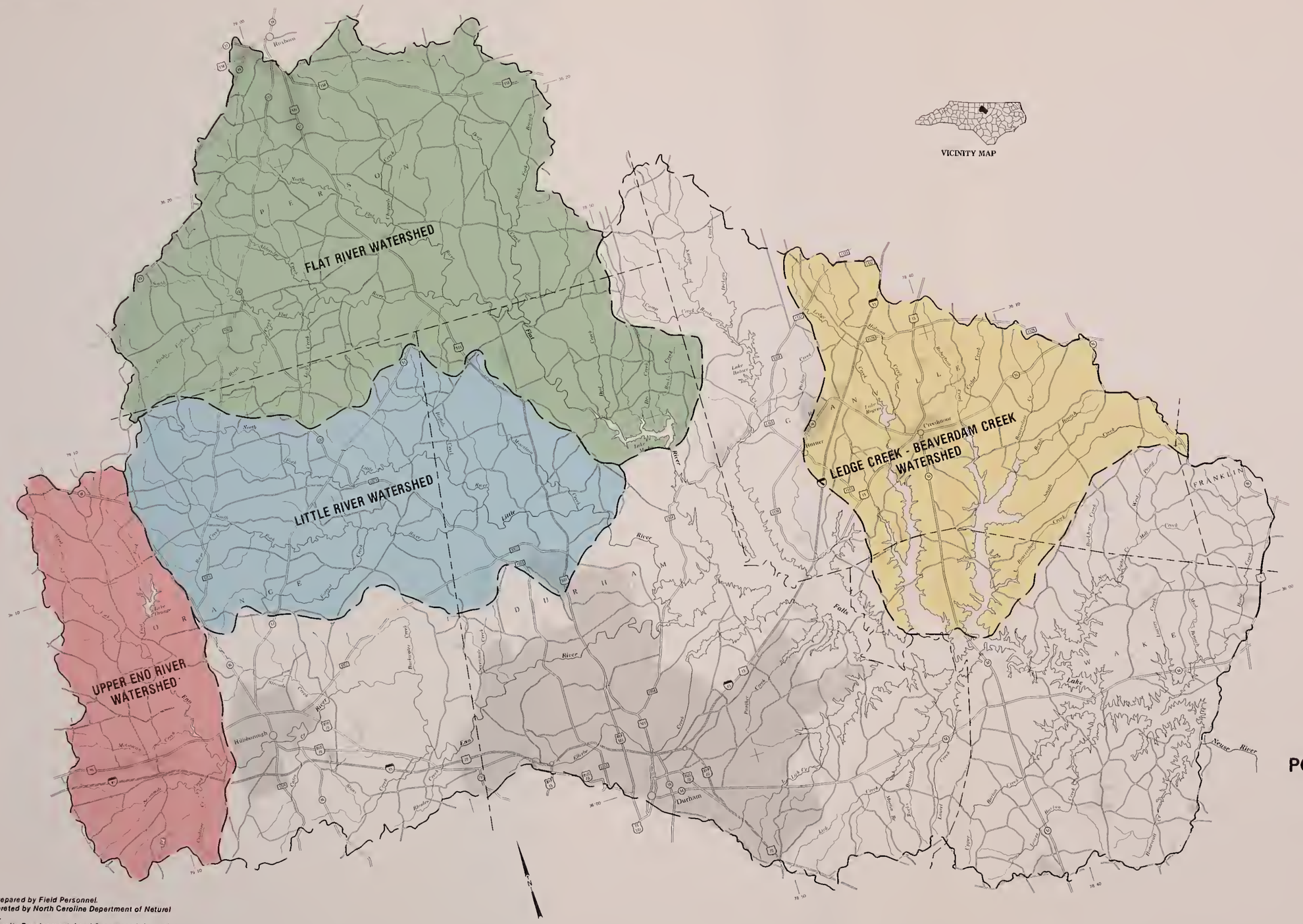
Material prepared by Field Personnel.
Maps generated by North Carolina Department of Natural Resources.
and Community Development, Land Resources Information Service.

JULY 1983 4-R-38299

USDA-SCS-FORT WORTH, TEXAS 1983

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



POTENTIAL PL-566 PROJECTS

UPPER NEUSE RIVER BASIN STUDY AREA

Portions of

DURHAM, FRANKLIN, GRANVILLE, ORANGE, PERSON AND WAKE COUNTIES
NORTH CAROLINA

Approximate Scale Miles

Approximate Scale Km

Material prepared by Field Personnel.
Maps generated by North Caroline Department of Natural Resources.
and Community Development, Land Resources Information Service.

JULY 1983 4-R-38309

USDA SCS-FORT WORTH, TEXAS 1983

APPENDIX B

Case Study Farm

Case Study Farm
Upper Neuse Study
Summary of Evaluations

A 787 acre case study farm in the Upper Neuse River Basin was used to estimate the effects of installing land treatment measures on value of production, costs of production, net returns, soil erosion, and land treatment costs. These effects influence landowner's decisions to voluntarily install and maintain land treatment systems.

About half the acreage was in corn and soybeans. The tobacco allotment was 20 acres. The rest of the farm was in hay and pasture. Following development of present conditions (1982), the following situations were evaluated for comparison with 1982 conditions:

1. no limit on funds available annually for installation and maintenance or recommended land treatment measures.

2. $5,000 available annually for recommended land treatment measures,

3. $2,500 available annually for recommended land treatment measures,

4. $1,000 available annually for recommended land treatment measures, and

5. adequate treatment of all acres eroding at 12 tons per acre or more annually with no limit on funds available.

Models were constructed to maximize net returns to land, management, and risk given land availability, costs and returns for various crops, and installation of land treatment systems under alternative situations (Table 1). Models were also designed to maximize reduction in soil erosion per dollar spent on land treatment systems subject to the same constraints on land availability and so on (Table 2). Current "normalized" prices were used for production inputs and outputs. Yields and cropping patterns among fields as provided by SCS were not allowed to vary before or following installation of land treatment systems, even though long-term erosion reduces crop yields. Holding cropping patterns fixed reflects an SCS view of field by field planning for reducing or controlling erosion rather than farm planning. The inventory of land use, erosion, and treatment needs conducted by SCS for the Upper Neuse, including the case study farm, was conducted on a field by field basis. A land treatment system was developed for each field. Since a decision was made to conduct evaluations in this "static" environment, value of production and net returns did not vary much among most situations being evaluated. In fact, value of production only changes when cropland is converted to field borders in some of the land treatment alternatives.

Compared to present conditions, installation of the full treatment program is the most effective in reducing soil erosion from 6,280 to 2,820 tons/year, a 55 percent reduction (Table 1). This is also the

most costly approach with net returns reduced by about 50 percent. Most of this reduction is due to an annualized cost of $23,700 to install and maintain the recommended practices. This averages $30/acre/year across the cropland and pasture land. To achieve this, the landowner would need to annually set aside $23,700 of the $49,600 of present returns, receive $23,700 annually from some public program, or be in a position to use some combination of these sources of money.

If the most severely eroding cropland--12 tons/acre/year or higher--were adequately treated, erosion would be reduced by 35 percent but at an annual cost of $7,700 (Table 1). Net returns would be about 18 percent below the present level. As the dollars available for treatment decrease from $5,000 to $1,000/year, there's a shift away from the more costly structural measures to conservation tillage and residue management only.

A similar pattern of results are derived when the reduction in soil erosion per dollar spent on land treatment systems is maximized (Table 2).

The percent reductions in annual soil erosion from the present level for alternative situations evaluated are as follows:

Alternative	Percent Reduction in Erosion	
	Maximize net returns to land, management, and risk	Maximize reduction in erosion/dollar spent on land treatment
	Percent	
No limit/year	55.1	55.1
$5,000/year	22.9	33.0
$2,500/year	10.0	18.5
$1,000/year	2.2	5.9
Treat land eroding ≥ 12 tons/acre/year	34.7	34.7

The alternatives that reduce erosion the most are also the most costly to the landowner and(or) the public. In addition to dollar cost in Tables 1 and 2, the dollar costs per ton of soil erosion reduced are given below. The difference in net returns between present conditions and each alternative is divided by the corresponding difference in levels of soil erosion.

Alternative	Percent Reduction in Erosion: Maximize net returns to land, management, and risk	Percent Reduction in Erosion: Maximize reduction in erosion/dollar spent on land treatment
	Percent	
No limit/year	7.2	7.2
$5,000/year	3.6	2.6
$2,500/year	4.0	2.3
$1,000/year	7.1	2.7
Treat land eroding ≥ 12 tons/acre/year	4.0	4.0

The lowest cost per ton reduction in erosion is apparently realized by spending more than $5,000/year but less than $23,700/year. The dollar costs per ton reduction are the same or lower if the landowner allocates dollars available for installing land treatments so to maximize reduction in erosion/dollar spent on treatments rather than maximize net returns. Net returns with the two approaches are similar (Tables 1 and 2).

While using annualized costs for land treatments is appropriate in these evaluations, the fact that landowners incur the entire cost at the time of installation and not the annualized cost should be emphasized. For example, the annualized cost of conservation tillage is $10/acre. However, if the landowner does not have no-till planter, the immediate cost of shifting from conventional to conservation tillage is really $8,000 or so for a new no-till planter and not $10/acre/year.

The evaluation of the case study farm in a "static" environment places emphasis on the short run costs of conservation measures. Another perspective is gained by considering the long-term consequences of soil erosion. Some of these consequences are summarized in the following quotation:

> "If the effect of soil loss on the productivity of the soil is not significant enough to alter farmers' net returns within their planning period there is no economic incentive for farmers to reduce soil loss to tolerance levels (or T-limits). However, the effect of accumulated soils loss on soil productivity may be realized beyond the farmers' planning period which may be one or more years.
>
> From a societal viewpoint, the trade-offs between soil loss and environmental quality, and between soil loss and future soil productivity are apparent. For an individual farmer, a key determinant of the benefits of reducing soil loss or soil conservation is the effect of current soil loss on future productivity within the farmers' planning period.

The soil provides replaceable inputs such as plant nutrients and organic matter, and an environment favorable for plant growth. The soil environment variables such as water-holding capacity and tilth generally become less favorable to plant growth as some of the soil profile is removed because of erosion. The soil also becomes poorer in plant nutrients and organic matter as topsoil is lost to erosion. Thus, with the loss of topsoil, increased amounts of plant nutrients will have to be artificially supplied to maintain original crop yields. However, on many soils, even with increased levels of artificially supplied nutrients, crop yields cannot be maintained at lower levels of the soil profile because of reduced water-holding capacity of the soil and limitations on plant root growth (Larson, 1982).

Therefore, if current levels of soil loss result in the loss of topsoil in the future, which leads to a reduction in crop yields and increased use of inputs, some future returns from farming are foregone. Technological developments, such as new hybrids, may permit the same or higher crop yields even after some of the topsoil is lost to erosion. In such cases, it is difficult to perceive the effect of reduced soil depth on crop yields. However, if future technological improvements are considered, reductions in crop yields because of current soil erosion may decrease potential gains in productivity." 1/

ASSUMPTIONS AND PROCEDURES

Cropping Patterns

Wheat is always double cropped with soybeans. The tobacco allotment is 20 acres. All production is nonirrigated.

Cropping patterns were not permitted to vary from present conditions regardless of land treatment systems installed. Crop acreages are as follows:

1/ Bhide, S., C. A. Pope III and E. O. Heady, 1982. A Dynamic Analysis of Economics of Soil Conservation: An Application of Optimal Control Theory, Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa.

	acres
Corn	186
Soybeans	186
Tobacco	20
Wheat (double cropped)	186
Alfalfa	87
Other hay	75
Pasture	233
Total	787

The following rotations were used for all cropping situations:

Rotation	Crops	Acres
1	corn (1 year) wheat/soybeans (1 year)	329
2	alfalfa (4 years) corn (1 year) wheat/soybeans (1 year)	131
3	tobacco (1 year) other hay (3 years)	94
4	pasture (continuous)	233

Costs and Returns

Estimated costs and returns for each cropping sequence on each field were calculated. Production costs are from the SCS Technical Guide, Section V-C, dated January, 1981. Land treatment costs were developed by SCS. Costs of SCS technical assistance are not included. No allowance for cost-sharing through ACP programs was included. Total revenue (value of production) are based on yields times "normalized" prices. No land charge or rent is included in production costs.

Land Treatment Systems

SCS developed land treatment systems for each field. Each system will reduce sheet and rill erosion to "T" or less. Installation of land treatment systems was assumed to have no impact on yields. The annualized costs of installing and maintaining land treatment systems were provided by SCS.

Evaluation with Static Conditions

All evaluations are made at a point in time. Present conditions reflect 1982 relationships. No changes in yields or cropping patterns were allowed when impacts of installation of land treatments were evaluated. Alternative land treatment systems for individual fields were not considered. Field size and shape were not allowed to vary. Prices received and paid were unchanged throughout all evaluations.

Table 1. Annual costs and returns, levels of soil erosion, and land treatment systems for present conditions and for alternative land treatment programs when net returns to land, management, and risk are maximized under static conditions--Upper Neuse Case Study 1/

	Present Conditions	No limit/year	$5,000/year	$2,500/year	$1,000/year	Adequately treat all land eroding > 12 tons/ac/yr.
Land in farm(ac)	787	787	787	787	787	787
Value of production($)	228,400	226,400	227,700	228,400	228,400	227,000
Costs of production($) 2/	178,800	201,800	183,300	181,300	179,800	186,200
Net returns to land management and risk($)	49,600	24,600	44,400	47,100	48,600	40,800
Soil erosion (tons/year)	6,280	2,820	4,840	5,650	6,140	4,100
Land treatments						
Total cost($/yr) 3/	0	23,700	5,000	2,500	1,000	7,700
Crop rotations(ac)	554	554	554	554	554	554
Conservation tillage(ac)		263	150	135	16	31
Residue management(ac)		62	58	58	42	
Field borders(ac)		7	2			5
Grass waterways(ac) 4/		196	46			164
Terraces or diversions(ac) 4/		133	40			133
Pasture management(ac)		209				
Pasture re-establishment(ac)		10				

1/ Models formulated to maximize net returns to land, management, and risk subject to availability of land and specified land treatment systems. Yields and cropping patterns for present conditions are the same as those for treated conditions. Prices of production inputs and outputs are in terms of 1982 "normalized" prices.
2/ Include costs of land treatment systems and tobacco allotment leasing at $.50/lb. No ASCS or other cost-sharing for installing land treatments is included.
3/ Annualized cost of installing and maintaining land treatment systems. Costs of SCS technical assistance are not included.
4/ Includes all acres in fields treated not just the areas of fields on which waterways, terraces, or diversions are located.

Table 2. Annual costs and returns, levels of soil erosion, and land treatment systems for present conditions and for alternative land treatment programs when net returns to land, management, and risk are maximized under static conditions--Upper Neuse Case Study 1/

	Present Conditions	No limit/year	$5,000/year	$2,500/year	$1,000/year	Adequately treat all land eroding >12 tons/ac/yr.
Land in farm(ac)	787	787	787	787	787	787
Value of production($)	228,400	226,400	227,300	228,000	228,400	227,000
Costs of production($) 2/	178,800	201,800	183,100	181,100	179,800	186,200
Net returns to land management and risk($)	49,600	24,600	44,200	46,900	48,600	40,800
Soil erosion (tons/year)	6,280	2,820	4,210	5,120	6,140	4,100
Land treatments						
Total cost($/yr) 3/	0	23,700	5,000	2,500	1,000	7,700
Crop rotations(ac)	554	554	554	554	554	554
Conservation tillage(ac)		263	231	232	100	31
Residue management(ac)		62				
Field borders(ac)		7	3.3	1		5
Grass waterways(ac) 4/		196	65	32		164
Terraces or diversions(ac) 4/		133	32			133
Pasture management(ac)		209				
Pasture re-establishment(ac)		10	10			

1/ Models formulated to maximize reduction in soil erosion per dollar spent on land treatment systems subject to availability of land and specified land treatment systems. Yields and cropping patterns for present conditions are the same as those for treated conditions. Prices of production inputs and outputs are in terms of 1982 "normalized" prices.
2/ Include costs of land treatment systems and tobacco allotment leasing at $.50/lb. No ASCS or other cost-sharing for installing land treatments is included.
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